EnerTEG Platform Manual

Version 1.14

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Chapter 1. Introduction

Located at the heart of all European Data centre hubs, in the Czech Republic, our Power Distribution Units have been manufactured since 2008 using local components. CONTEG's mission is to provide reliable and easy to control power distribution. We focus on refining and perfecting PDUs to meet demands of today's Data centres, industrial facilities and any environment where reliable power distribution is critical.

Our latest innovation, PDU 5.0, embodies our commitment to excellence. Developed in collaboration with over 40 data center operators, it sets a new standard in PDU design. The ability to have the software centralised has lead to even more powerful intelligence options, with substantial increases in hardware performance. A new centralised software option saves on expensive hardware and power usage, as this approach requires only PDUs acting as data conduits.

EnerTEG is our software for PDU 5.0. EnerTEG Platform is installed externally on a server. The EnerTEG products provide energy monitoring and control for CONTEG PDU 5.0 products. The EnerTEG user interface has been designed from the beginning to be easy to use.

Distributed monitoring and control systems have often been demonstrated to provide a better, more intelligent and more flexible way to collect and manage large amounts of data provided by current energy and sensor sources. These distributed monitoring and control systems analyse and display data from associated parts of the Data centre.

Unlike traditional PDUs, which embed intelligence within each unit, the Gateway module PDU offers the opportunity to shift the intelligence to a central server or computer device with EnerTEG Platform installed. This approach optimises the hardware required within the PDU as it functions as a data conduit which significantly reduces cost. This opens up a new performance level and a feature-set that was not possible before and is not possible otherwise.

The Daisychain module PDU enables easy expansion of the network via the Databus connections of a Gateway module PDU. In a Databus ring configuration of up to 100 PDUs total, only one Gateway module PDU is required to communicate, which saves up on IP address space.

With PDU 5.0, CONTEG provides a high quality and modular answer to the vast variety in project requirements and designs.

1.1. Disclaimer

While we strive to provide accurate and up-to-date information in this manual, please be aware that there may be an occasional error or inconsistency in the text or the descriptions.

Chapter 2. Overview

EnerTEG is our Power Monitoring software for PDU 5.0. Because EnerTEG Platform installed as a virtual machine on a server centralises all Gateway module PDUs, it has more advanced features compared to a Controller module PDU with the EnerTEG Lite software embedded on the Communication module; An increased amount of devices in the system is allowed, there is support for our third generation PDUs and more advanced reporting and system integration.

Overview

Feature	EnerTEG Platform
Maximum number of PDUs in system	10.000
Maximum number of Databus rings supported	1000
Maximum number of PDUs in one ring (single IP address)	100
Measurements refresh rate	Once/s
Auto discovery of new added Databus PDUs	Yes
Aggregation of measurements on room/row/rack level	Yes
Supports CONTEG generation 2 and 3 devices	Yes
Multiple roles and permissions	Yes
Configurable thresholds for all measurements (warnings/alerts)	Yes
Dashboarding	Advanced
Creation of reports	Advanced
Scheduling of reports	Yes
Export of data to files or database	Yes
Logging and auditing	Advanced
Back-up (configuration, log files)	Yes
Updating	Yes
PDU Communication module Compatibility	Gateway module
Type of software	Virtual machine software
Installation	Externally on server or computer
Scalability	Supports up to 10.000 PDUs with performance limited only by the capabilities of the server / computer
DCIM integration	Full integration
Supported protocols	HTTP/HTTPS, REST API, Modbus, Redfish, SNMP V2C & V3 (including traps), SMTP, NTP, LDAP, SSH
Security protocols	Strong password config, user & role management, Active Directory, LDAP/S integration, SSL/TLS 1.3, HTTPS
User management	Customizable roles, permissions and group management
Control and alerts	Configurable thresholds for all measurements on PDU and room/row/rack level

Feature	EnerTEG Platform
Threshold type	Fourfold: critical and warning thresholds, and upper and lower thresholds can be set across all PDUs / branches / outputs / inputs possible through an innovative rule-setting system, also configurable from system-wide to Data centre element level.
Alert notification	Optional E-mail dispatch of alerts or notifications
Real-time monitoring	All PDU measurement values
Inputs, branches and outlets measurements	Voltage, voltage dip and peak, current, current peak, neutral current, watts, apparant power, reactive power, energy, apparant energy, residual current, total harmonic distortion, crest factor, frequency, power factor
Data dashboarding	Advanced
Data logging and reporting	Advanced
PDU Monitoring and management	Multiple PDU (PDU 5.0 and generation 2/3) and their Databus rings
Environmental monitoring	Supports sensors for temperature, humidity
Backup options	Configuration, log files
Updating functionality	Yes
Report creation	Reporting of all measured values in tabular and graphical form, optionally available as an Excel download.
Scheduled reports	Yes
Data insight	Overviews with data of multiple PDUs, rooms, rows, racks, and also detailed views of PDU or inlet / branch & outlet specific measurements.

Chapter 3. Installation

Figure 1. EnerTEG

3.1. EnerTEG Platform

EnerTEG Platform is available as a Virtual Machine. The requirements to install and use the CONTEG EnerTEG Platform:

- vSphere / ESX / ESXi minimum 4.1
- vCPUs 2 (minimum, can be increased)
- Memory minimum 4GB recommended
- Hard Disk minimum 32GB (should not be reduced). 48GB is recommended.
- Network adapter
- Video card 4MB

3.1.1. Import virtual appliance (for VMware)

The exact installation and operation of a virtual CONTEG EnerTEG Platform will depend on the server that is provided by the customer. Minor differences will be found depending on whether EnerTEG Platform is installed with admin rights or not. The CONTEG EnerTEG Platform product is available as an OVA file for installation in a virtualization product. Depending on the customer requirements, this special CONTEG can run with or without root system access.

1. Make sure to setup the virtualization environment first.
2. Download EnerTEG-platform-current_version.ova from our website: https://download.conteg.com/PDU/IP-S/EnerTEG-dcem/
3. Create a new virtual machine and give it the EnerTEG name
4. Make sure the VM is configured to the requirements of the software. These are the minimum requirements, for better performance please increase cpu, memory and storage requirements.
5. Select the provided OVA file and add this to the system.
6. Resize the data partition if required for the appropriate amount of storage.
7. Setup the desired Ethernet adapter configuration.
8. Start the Virtual Machine.
9. There should be assigned a IPv4/IPv6 IP address which the console will display after boot (if not, change the virtual machine network settings).

10. Navigate to the IP address set for the virtual machine or check the router for the assigned IP address if no display is available.
11. Login and start using EnerTEG.

3.1.2. Manually create a virtual machine

Hyper-V

For Hyper-V use, there is a VHDX and possibly a DVD ROM image available. Below are the steps to set it up.

1. Make sure to install a Hyper-V Manager.
2. Click on new and select Virtual Machine.
3. Specify the name and location.
4. Specify the generation, make sure to select generation 2.
5. Assign memory, 4GB RAM or more is recommended.
6. Configure networking, set it to extern.
7. Connect a virtual disk, select the VHDX file as an existing hard disk.
8. Do not start the VM yet, go to settings.
9. Click on SCSI controller and add a DVD drive.
10. Set it to location 2 and select the image file 'config' that was delivered along the VHDX file.
11. Click Apply and go to Security.
12. Disable Secure boot.
13. Start the virtual machine.

QEMU/Proxmox

The standard image we have (the OVA file) will also support all QEMU based products including Proxmox. Since all QEMU products are a little different we cannot provide detailed setup instructions, so this installation only recommended for advanced users.

Key notes: - System needs to be set up as EFI (OMVF) system, not BIOS. - VirtIO SCSI for storage is required. - 4GB or more of RAM recommended. - the CD (ISO) image that is part of the OVA should be added to the virtual machine.

Below are screenshots that show how a working setup might look like in Proxmox:

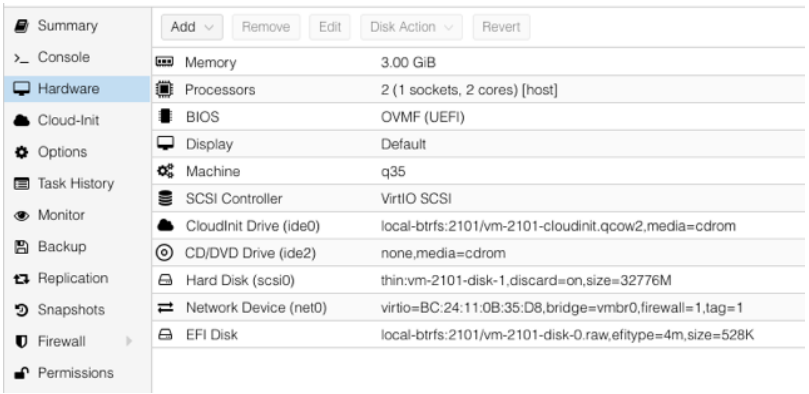


Figure 2. Proxmox hardware

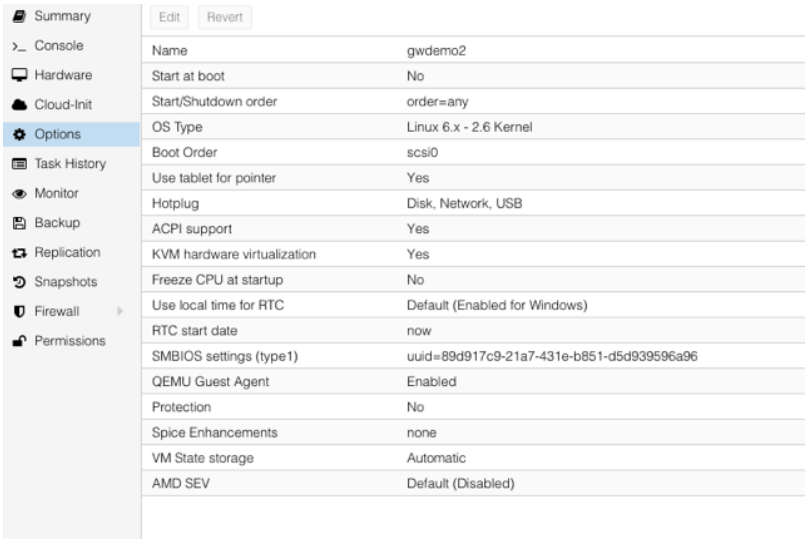


Figure 3. Proxmox options

3.1.3. Docker

We provide a EnerTEG Platform Docker container for use with Docker and Docker compose. On our website we provide a docker-compose.yaml file for this purpose. Because EnerTEG Platform requires a preconfigured setup of a database to function, the YAML file also provides the creation of a preconfigured database. Should there be no existing on-premise database, the provided MariaDB service can be used. The prerequisites are that Docker and Docker Compose are installed on the system.

Docker and Docker Compose installation

1. Download and install Docker from https://www.docker.com/.
2. Follow the installation instructions for your operating system.
3. Verify the installation by running 'docker --version' in the command line.
4. Docker Compose is included with Docker Desktop. Please see https://docs.docker.com/compose/install/ for installation instructions if you are using Docker Engine.
5. Verify the installation by running 'docker-compose --version' in the command line.

The provided 'docker-compose.yaml' file defines two services: mariadb and EnerTEG.

MariaDB

MariaDB provides a database for EnerTEG if no on-premise database is available. Comment out the `mariadb` service in the `docker-compose.yaml` file if you have an existing database.

- Default user: `EnerTEG` without captitals.
- Default database: `EnerTEG` without capitals.
- Password: Replace `PASSWORD_CHANGE_ME` with a strong password.
- Database data is stored in the `mariadb-data` volume.

EnerTEG

- Connects to the MariaDB service by default.
- Ports: `8080` (Web server), `1162/udp` (SNMP traps).
- Environment variables:
  - gw_db_engine: Database engine (default: MYSQL - which is for MariaDB / MySQL. Can be set to MSSQL to use an MS SQL).
  - gw_db_host: Hostname of the database (default: `mariadb`, which is the hostname docker compose sets up to use the database from the top Mariadb service).
  - gw_db_name: Database name (default: `EnerTEG` without capitals).
  - gw_db_user: Database user (default: `EnerTEG` without capitals).
  - gw_db_password: Database password (must match the MariaDB password).

1. Replace `PASSWORD_CHANGE_ME` in the `docker-compose.yaml` file with a strong password in both the mariadb and EnerTEG services.
2. Start the services: `docker-compose up -d` in the command line (navigate to the folder with the configuration files first).
3. Access the EnerTEG web interface at `http://<your-server-ip>:8080`.

3.1.4. Gateway module PDU without DHCP server availability

Before starting Gateway module PDU configuration; make sure that EnerTEG Platform is up and running and also make sure that the Gateway module PDUs are reachable for EnerTEG Platform on the network at port 80 / 443.

To configure the IP address of a Gateway module PDU without DHCP, basic network configuration via a USB stick is required. There are two configuration options available. The most convenient configuration method is to make use of the Gateway module PDU configuration web page. The second option is USB configuration via a configuration file which can be used to configure multiple PDUs.

Webpage network configuration

The Gateway module PDU basic network configuration webpage can be reached by typing http://pdu5-[serial_number].local (e.g. http://pdu5-119411.local) in a browser. Link Local addressing makes use of autoconfiguration and mDNS. This is supported by all operating systems such as Windows and Linux.

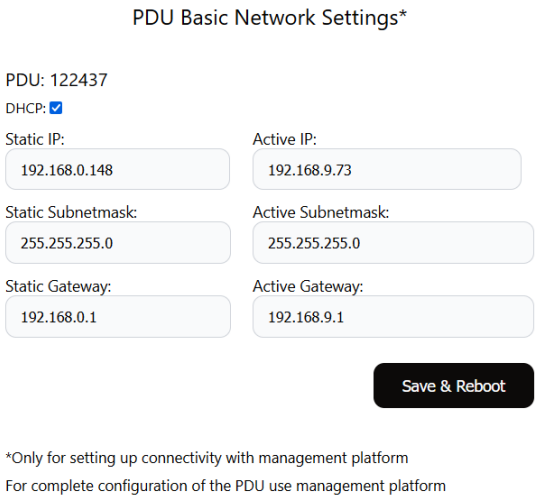


Figure 4. Basic network configuration webpage

- When filling in the configuration values, a value check is performed, which checks for entering incorrect values. The user will be notified which value is incorrect.
- Once the settings saved, the Gateway module PDU is restarted and becomes reachable on the new settings.
- Subnet cannot be 255.255.255.255, so it is impossible to make the PDU unreachable. If the IP is lost after changing the settings, the module can be scanned with the PDU Display App to obtain the IP address that was set.

For security, once a Gateway module PDU is added as a connection to EnerTEG the basig network configuration interface will not be reachable. The web interface will become available again only when EnerTEG is unavailable or when the connection is removed from EnerTEG in the connection menu.

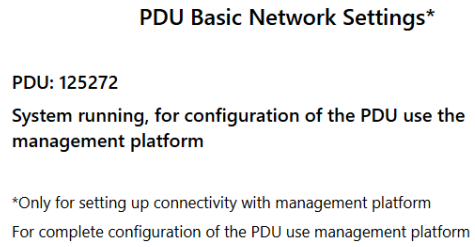


Figure 5. Webpage once connected

USB network Configuration

A: Prepare the USB stick with the PDU configuration

- Format an empty USB stick to FAT32.
- A config.txt file needs to be created on the root folder of the USB stick in a specific format (also include the header line) as in the example below.

serialnumber;eth0ip4;eth0mask;eth0gw;dhcp_enabled
122345;192.168.9.55;255.255.255.0;192.168.5.1;0
125121;192.168.9.57;255.255.255.0;;1
128438;;;;1

- The serialnumber and the dhcp_enabled must always be filled, eth0ip4 and eth0mask can be empty when dhcp_enable is set to 1 or both filled.
- One log file will be created on the USB stick where each time a line is added containing the serial number, FAIL or SUCCESS, and the cause of a configuration fail should this happen.

B: Gateway module PDU USB Configuration procedure

1. Remove the Gateway module from the PDU.
2. Insert the USB stick with the config.txt file into one of the USB ports of the Gateway module (one of both USB ports can be used).
3. Attach the module back to the PDU, the LED ring will be blue.
4. Once the configuration is read, the LED ring will become orange, red or green for a few seconds (green = success, red = invalid config file, orange = no matching serial number).
5. The USB stick can now be removed, the Gateway module requires a reboot. Remove the module, wait a couple of seconds and reattach the module.
6. The IP address has now been configured and is known.

In case there is no DHCP server available and the USB-stick configuration is not used, the IP of the Gateway module has factory default address 169.254.1.10.

If your Gateway module has a firmware older than 0.20.2, a different approach is required (this can be verified using the PDU Display App). Please contact our support department for assistance.

3.1.5. Gateway module PDU with DHCP server availability

Before starting Gateway module PDU configuration; make sure that EnerTEG Platform is up and running and also make sure that the Gateway module PDUs are reachable for EnerTEG Platform on the network at port 80 / 443.

1. Obtain the IP address of the Gateway module PDU via the DHCP server.
2. The active IPv4 address of the Gateway module PDU negotiated by DHCP can also be obtained by scanning the Gateway module PDU with the PDU Display App. Download and install the PDU Display App. Scan the PDU and retrieve the active IPv4 address to connect to the PDU.

3.1.6. Adding a Gateway module PDU to EnerTEG Platform

1. Go to the EnerTEG Platform IP address in a browser and login (administrator first login; user: admin, password: admin).
2. Go to the general settings menu.
3. Make sure to set the EnerTEG URL correctly to allow for PDU firmware updates.
4. In the Connections section of the Settings menu, PDUs can be added by clicking “Add new connection” to enter the menu.
5. Select the correct device type, use username and password: admin / admin (which is the default password).
6. Enter the IP address assigned to the Gateway module.
7. After clicking “Apply” the software will automatically adopt the Gateway module PDU and all daisy chained PDUs connected to it.
8. Navigate to a rack.
9. In the rack menu it’s possible to assign PDUs to the rack by clicking on “Assign device to rack”.

The device assign popup menu will show a list of all unassigned PDUs when in the rack view, assign as many PDUs to a rack as required.

As soon as devices are assigned, values are calculated for the rack. The charts will start adding data but it may take one hour for the first data to be shown, because the charts show data on a hourly basis.

To change the IP address of a Gateway module on a DHCP address to a static address, go to the device list in EnerTEG Platform, select the correct device and click on Network ETH0. Set DHCP to off to start using a static IP address. Fill in the IPv4 address and a subnet prefix length. Save the changes and wait until the changes are processed. Now the module is on a different IP address than before so it won’t show up in EnerTEG Platform. Delete the connection from EnerTEG that the PDU was previously on and add a new connection with the static IP address that was set in the PDU. Now the PDU will be reachable again.

3.2. Daisychain module PDU

A PDU with a Daisychain module can be connected to the databus of a Gateway module PDU via standard network (UTP5) cables. We always recommend to connect Daisy-Chain PDUs on the databus in a closed ring situation, with both databus cabled connected. This improves performance and speed and creates a redundant communication line. The device will automatically become visible in the device list of EnerTEG via the Gateway module PDU once connected. Now the Daisychain module can be assigned to a rack in EnerTEG.

3.3. Software updates

EnerTEG can be updated to the latest version using raucb files, which can be downloaded from https://download.conteg.com/PDU/IP-S/EnerTEG-dcem/. Make sure to download the correct update file for EnerTEG Platform. To update EnerTEG, go to the Settings → General. In the 'System update or license install' section you can select the update file there. When the raucb file is selected press the 'Start Installation' button. Now the update will start, the update progress is displayed on the progress bar. EnerTEG will reboot after the installation. After a few minutes the update will be completed.

3.4. Network Requirements

Each data center's network environment is configured differently. It is important that the network requirements for an EnerTEG Platform installation are carefully considered in advance. The PDUs may be connected within a different IP range than EnerTEG Platform. Additionally, the client that ultimately needs to connect -possibly also using an IP address in a different range- must be able to reach the EnerTEG Platform. Plan and test this thoroughly in advance with all responsible departments.

- Communication takes place via port 80 for HTTP or port 443 for HTTPS.
- Websockets (WS) / Secure Websockets (WSS) are used, WebSockets start life as a HTTP or HTTPS request. During this initial request, the client asks the server to upgrade the connection. HTTP protocol upgrades and Long-lived connections (no aggressive idle timeouts) must be allowed in the firewall(s).

An easy way to test the connections is as follows:

1. Log in to the EnerTEG Platform CLI interface via the VM.
2. If desired, the EnerTEG IP configuration can be set via the CLI (see chapter Interfaces, CLI).
3. Using the CLI ping command, one of the PDUs can be pinged. If the command is successful, the EnerTEG Platform can reach the PDUs via the network infrastructure. If not, revalidate the EnerTEG and PDU network settings. If these are correct, the network administrator must configure the appropriate network access rules for this network route. Note: Verify that all PDUs are reachable; depending on your configuration, PDUs may be set to different IP ranges after installation.
4. The user sets up the device that needs to connect, for example, to the EnerTEG web interface. From the command line, initiate a ping command to the IP address of EnerTEG. If the command is successful, the user can reach the EnerTEG Platform via the network infrastructure. If not, revalidate the network adapter of the user's computer and the EnerTEG network settings. If these are correct, the network administrator must configure the appropriate network access rules for this network route.
5. If network access is correctly configured as described above, it should be possible to add PDUs to the EnerTEG Platform via the EnerTEG web interface on the user's computer.

Chapter 4. First use

4.1. First start

To start using EnerTEG, install EnerTEG Platform on a server first. The login page is displayed whenever a new user connects to EnerTEG via a browser. At the first start there is only one account (the administrator account). More accounts can be created by the administrator, each account can be assigned a role.

The administrator can login with user name “admin” and password “admin” during the first login. We strongly advise to change the password after the first time login.

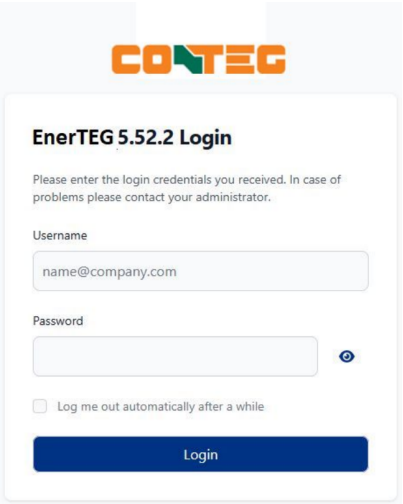


Figure 6. Login

4.2. Initial configuration

On the initial configuration, please open the settings page and validate / set the settings in EnerTEG accordingly. The Data centre structure can be set up and / or connections (containing PDUs) can be added to the system. First configuration on EnerTEG Platform will typically include entering the IP addresses of connections that contain PDUs with or without PDUs on the Databus.

For firmware updates to function correctly, make sure that the EnerTEG URL is set in the settings on the initial configuration when running EnerTEG Platform.

As for certificates to function correctly and to prevent serious issues in the future, it is of vital importance that the time of EnerTEG is set via an NTP server or manually synchronized. This can be done by logging in to the web interface of EnerTEG.

1. Go to settings and open the general settings, the date and time settings can be set here.
2. There are two options; set the date and time using an NTP server or set the time from the browser. Make sure the time is correct and the settings are saved after modifying them.

Changing the time during operation should be avoided, time should be set on the first start, doing this at a later point in time can result in gaps in the history database and graphs.

Chapter 5. Configuration

To open the application settings, click on Settings menu option.

5.1. General settings

The main application settings for EnerTEG.

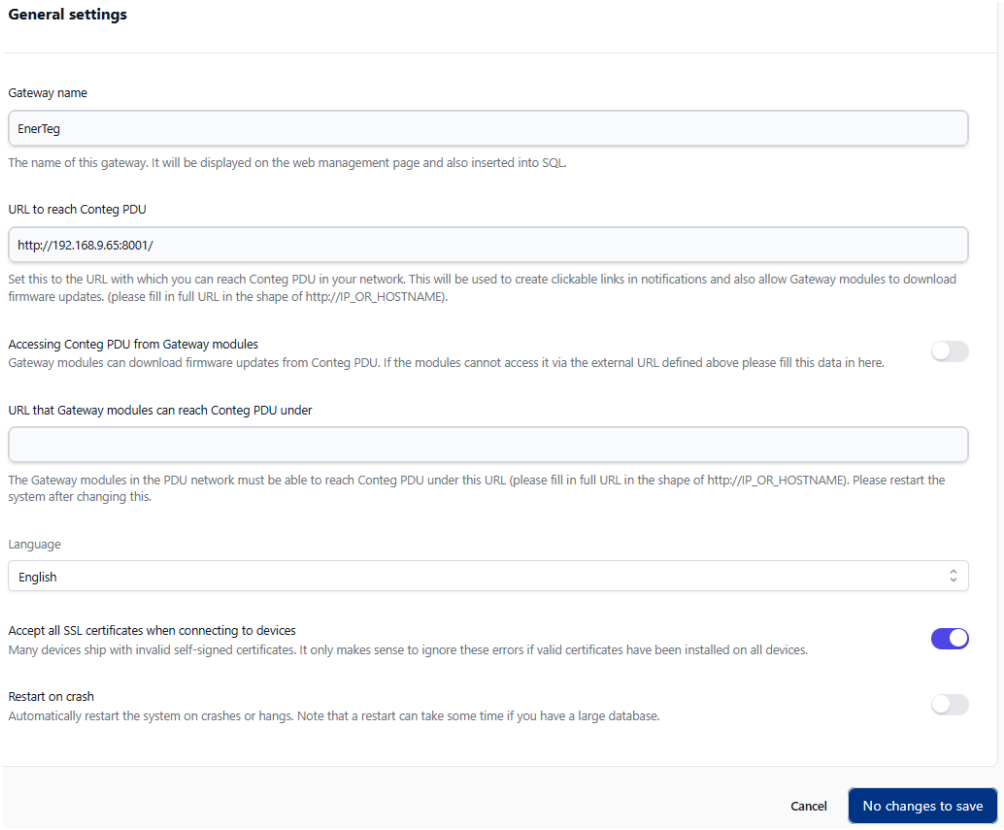


Figure 7. General settings

The name will be displayed as the header for all EnerTEG pages. The name is also used in notifications, and therefore in the E-mails and SYSLOG entries. Click “Apply” to apply the name. Administrators can select the language for EnerTEG, which will affect all aspects of the application. Click “Apply” to apply the new language.

Modern firmware is sent to the Gateway module using a POST command. For PDUs with older firmware, the URL to reach EnerTEG Platform needs to be provided. Set the value to the URL to the IP that EnerTEG is reachable on in the network. The value is used to create clickable links in notifications and also allows a Gateway module to download firmware updates. (please fill in full URL in the shape of http://IP_OR_HOSTNAME). If the modules cannot access it via the external URL defined above there is a second option. Please restart the system after changing this.

Many devices ship with invalid self-signed certificates, EnerTEG provides an option to accept all SSL certificates when connecting to devices. It only makes sense to ignore these errors if valid certificates have been installed on all devices.

For technical support, there is the option to enable remote management, which allows secure remote management access from the manufacturer. Also the application can restart automatically on crashes or hangs. Note that a restart can take some time if you have a large database.

5.1.1. System support

The system support section provides maintenance tasks for EnerTEG. Information such as the current version of EnerTEG with major, minor and patch version parameters can be viewed by the user.

Important during maintenance tasks is the quick restart function, which will restart the EnerTEG without restarting the operating system. The data and parameters are saved, and remain saved after the restart. An administrator can fully restart EnerTEG, it will shut down and restart the complete operating system (warm restart). No data will be lost. Also there is the option to power off, it will shut down and power off. It is safe to remove power afterwards.

When required, the software can be reset to the factory settings. This resets the EnerTEG database, deleting all data and configuration. Does not reset the configuration of connected devices. Warning: this can not be undone.

EnerTEG updates can be installed. The update file will be provided by CONTEG, and can only be installed on a EnerTEG system. When the “select file” button is clicked, the update file on the local file system must be selected. Make sure to select the correct update file for the correct EnerTEG version. It will then be uploaded to EnerTEG. After the upload process has completed, the software will update and restart, and this can take several minutes. After the update has completed, a new login will be required.

A copy of the EnerTEG logs can be downloaded for further analysis. In the event of issues during EnerTEG operation, it can be helpful to have additional information to help the analysis. The internal log files will be collected and uploaded to the download directory on the management system.

5.2. Web access

Access to EnerTEG is mainly done via a HTTP, or HTTPS connection from a browser. The default setup permits HTTP, but EnerTEG can also be set up for secure HTTPS connections. The default certificate supplied with EnerTEG is self-signed. Browsers may sometimes display warnings that the user can choose to ignore in order to continue using EnerTEG. This certificate can however be replaced by a user defined certificate and key.

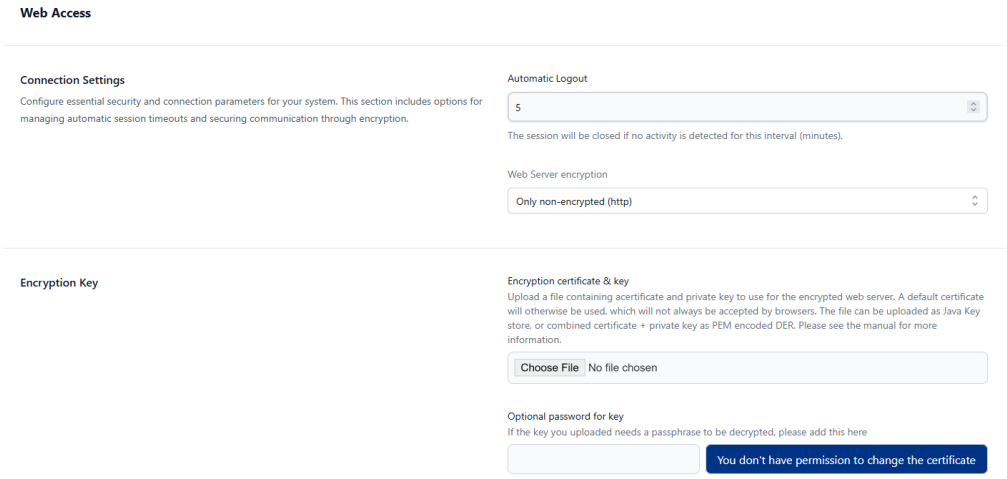


Figure 8. Web access

The Web Server encryption has multiple configuration options such as a non-secure Web Server. When disabled, the port 80 access (unsecure) will be blocked and redirected to the HTTPS (port 443). This effectively removes the possibility to access EnerTEG via an unsecured connection.

Another option is to use the encryption certificate & key, which means a valid certificate with its private key can be pasted into the field (this is normally a PEM file). The file must contain both the certificate and the private key are necessary to provide a secure TLS connection. Both parts should be concatenated into one file. If the certificate is invalid or the key is missing, then EnerTEG will return to using the default unsigned factory certificate. EnerTEG will require a restart before the new certificate will be activated. If the private key is protected with a password, then the password must be entered in the designated field.

The browser wants to connect to the CA, but if it is in a closed network, it cannot go to an external CA for verification. By adding your own certificates, the system can be given a trusted certificate.

Certificates have a maximum lifetime. When the certificate expiry date is reached the HTTPS connection will stop working so make sure the certificate does not expire, because no more (secure) access will be possible. At the next EnerTEG restart the standard HTTP setting will be used, and the certificate can be replaced.

The Network setting page provides the current network status information and IPv4/IPv6 connection configuration for one or more specific network interface(s) available in EnerTEG. To set a static configuration:

1. Set DHCP to off.
2. Put in the IP address.
3. Put in the correct subnet prefix length.
4. If required: set the gateway address and the DNS values.
5. Save the configuration, wait until the changes are processed. The interface is now reachable on the new static IP address.

IPv6 has additional settings such as IPv6 RA. When enabled, EnerTEG will attempt to retrieve a valid IPv6 address and default route through Router Advertisements. Note: Is not capable of retrieving DNS server information without an existing DHCPv6 server.

Enabling Local Link Addressing, EnerTEG will automatically generate an IPv6 address based on the MAC address of the interface used for local communication. Additionally LLA fallback can be enabled, which assigns a static IPv6 if IPv6 LLA fails.

5.3. Connections

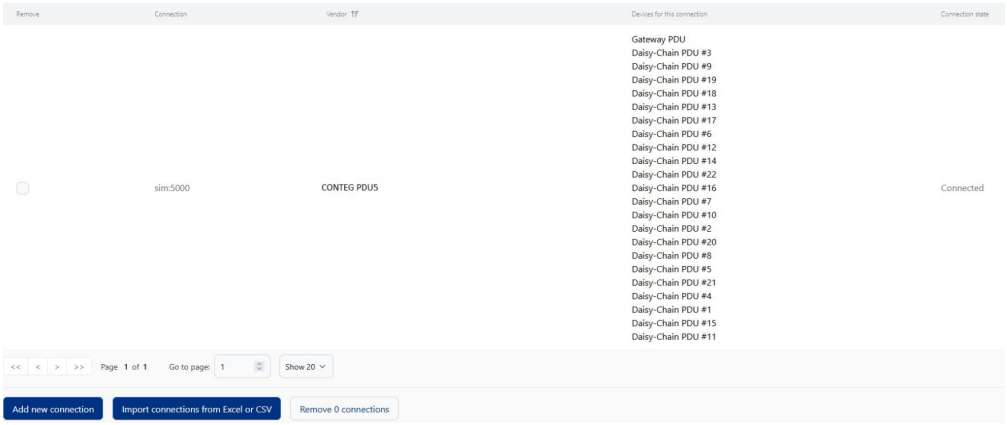


Figure 9. Connections

New devices can be added or deleted into the active EnerTEG configuration using this page.

For more information, see chapter 'Adding connections/devices (EnerTEG Platform only)'

5.4. Syslog

EnerTEG is able to export notifications to an external Syslog server of choice. When using the Syslog client, data is sent via BSD Syslog UDP/TCP. The external server should confirm to the RFC 5424 standard. This function is disabled by default, and will need to be activated with the “enable Syslog client” button. Any changes made to the settings need to be saved by clicking the “Apply” button.

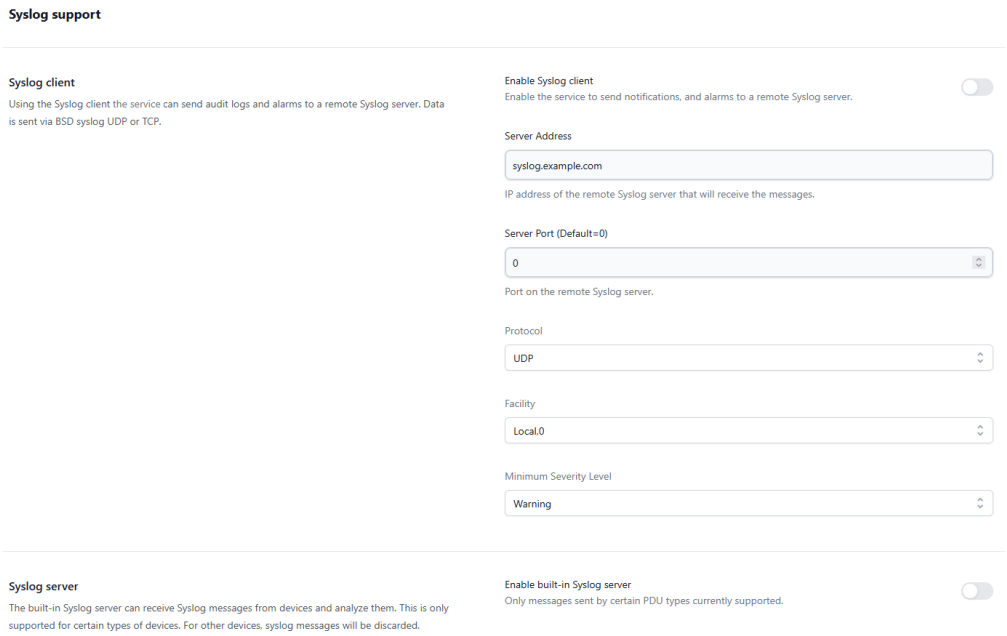


Figure 10. Syslog

The TCP IP name / address and port of the target Syslog server must be added when Syslog is to be used. If the remote Syslog server will be using the default port number, this field can keep the default value of 0. If this is not the case, please enter the correct value. The remote system manager can specify to which facility the Syslog entries from this EnerTEG appear. Administrators are able to select which notifications are exported. Notification messages have a severity level, these severity levels can be used to filter which messages are exported through Syslog.

The built-in Syslog server can receive Syslog messages from devices and analyze them. Only messages sent by certain PDU types are currently supported. For other devices, all Syslog messages will be discarded. This functionality can be enabled by pressing the "Enable built-in Syslog server" button.

5.5. SNMP agent

A SNMP agent can be queried via the SNMP protocol by SNMP clients. Remote SNMP browsers can access EnerTEG devices, optionally using the EnerTEG generic MIB file.

The SNMP agent is disabled by default, but can be enabled by the administrator, enabling the service to which a remote SNMP manager can poll for device data. Port 161 is the default port setting, as most SNMP devices are using the standard SNMP port. The MIB file for this agent is available for download from EnerTEG. Data from all connected devices is included in the SNMP data. Any changes need to be committed by clicking the “Apply” button.

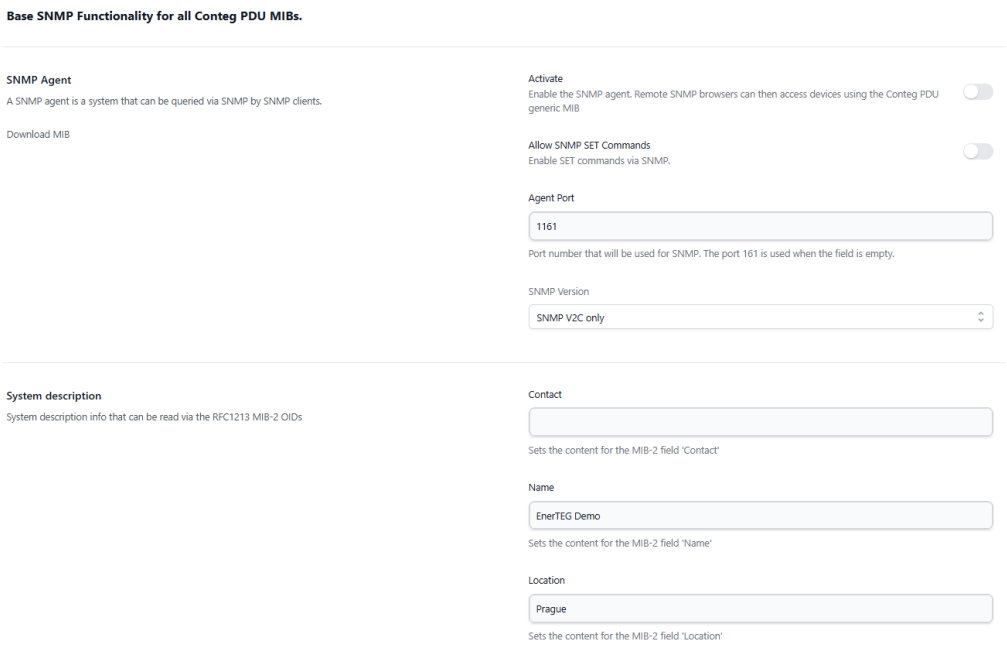


Figure 11. SNMP Agent & System Description

The SNMP agent can be enabled or disabled by the administrator, in addition, allowing SET commands via SNMP can also be enabled or disabled. For the SNMP agent to function correctly, a specific port number designated for SNMP could be set, but in most cases the default value can be kept (port 161 is used when the field is empty). Additionally the SNMP version should be specified, with the options V2C Only / V3 Only / V2C and V3 available.

The system description contains settings for the MIB-2 fields 'Contact', 'Name' and 'Location'.

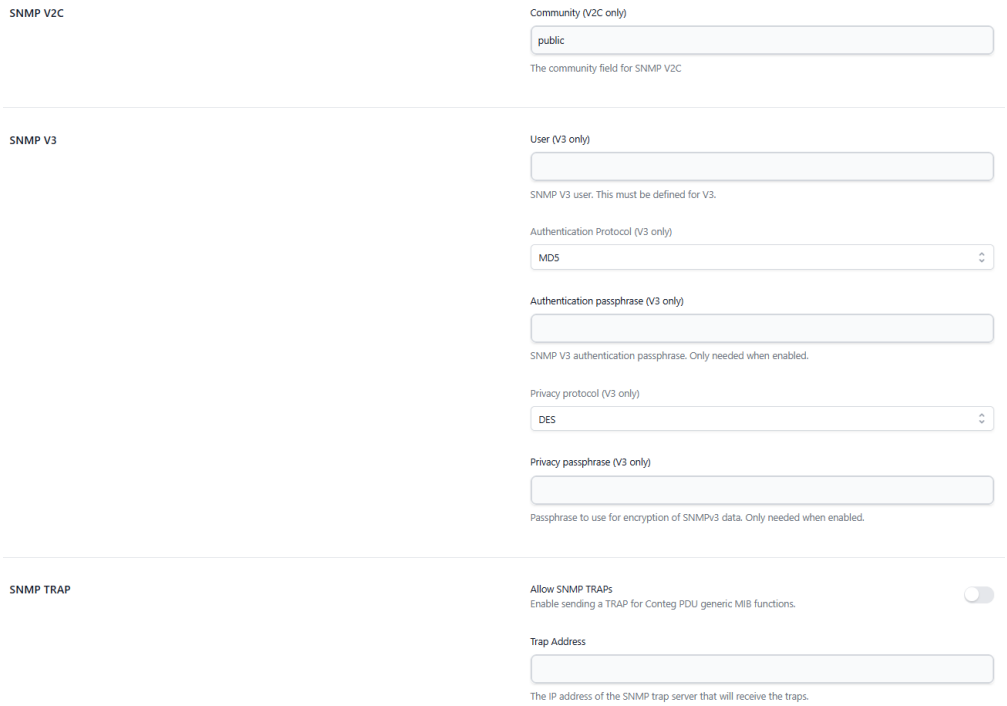


Figure 12. SNMP V2C / SNMP V3 / SNMP TRAP

SNMP V2C uses a community read and write password, which should be set if SNMP V2C is to be used. If SNMP V3 is to be used, more fields require setup. For example the user must be defined. Also the correct authentication protocol such as MD5 and the authentication passphrase is needed when enabled. Additionally the privacy protocol (e.g. DES) and privacy passphrase to use for encryption of SNMPv3 data should be added.

EnerTEG supports SNMP TRAPs which enables sending TRAPs for EnerTEG generic MIB functions. The TRAP address can be specified, which is the IP address of the SNMP trap server that will receive the TRAPs. The format needs to be: 'IP:Port'. When SNMPv3 traps are to be used, in addition to the authentication and privacy login data the engine id must be obtained and used by the client.

5.6. Modbus server

Activate the Modbus TCP server to allow Modbus clients to connect and read data. Please ensure that no unauthorized access over the network is possible, since Modbus is inherently insecure, unencrypted and without any access control. Optional: allow Modbus clients to write values to device registers (e.g., outlet control, naming). This configuration option is disabled by default. The Modbus register list can be downloaded from our website.

5.7. E-mail services

EnerTEG can send notifications by E-mail to a list of recipients via an external E-mail server. This function is disabled as default, but can be enabled. To minimize the number of Emails sent out, a “Delay Timer” can be defined to collect multiple notifications and send them in one Email. High severity level notifications can, however, be set to be sent immediately. Any changes need to be committed by clicking the “Apply” button.

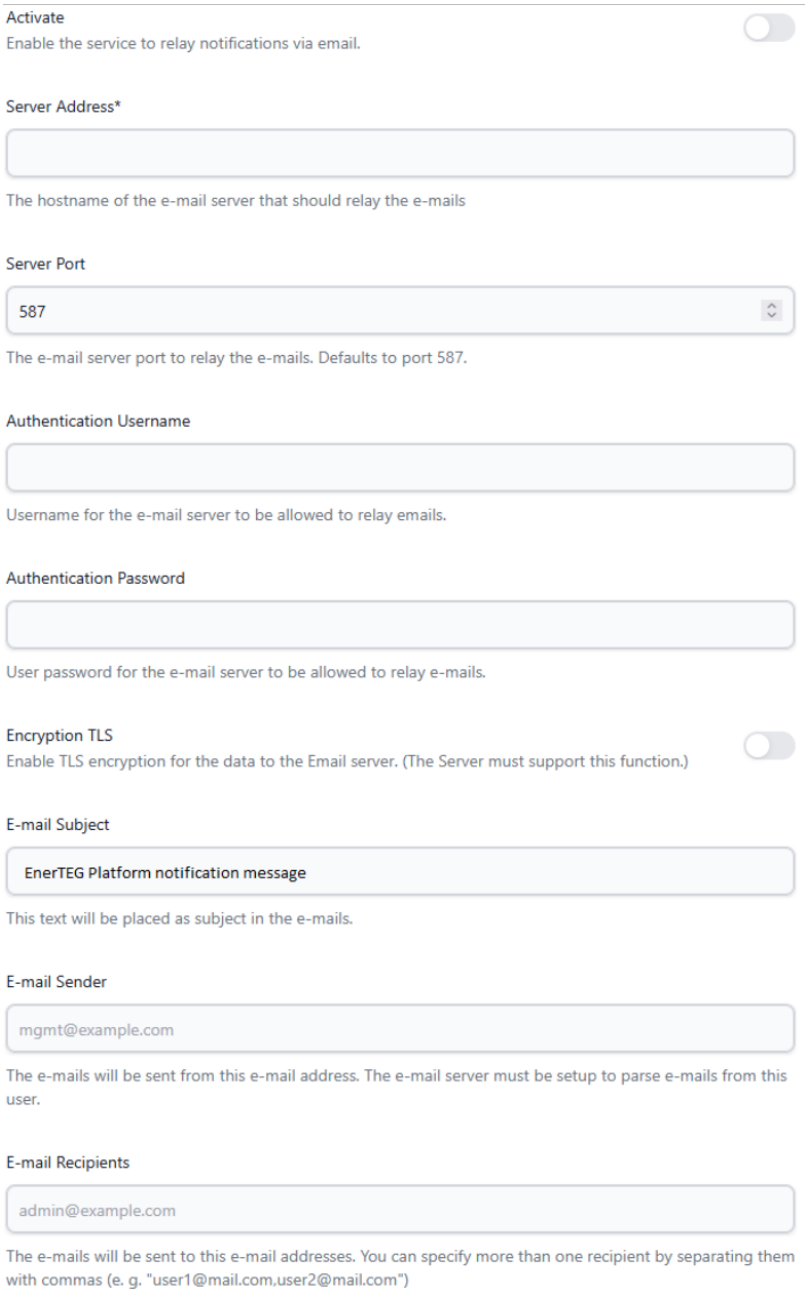


Figure 13. E-mail services

Enable the e-mail service to relay notifications via email. This requires the hostname and port of the e-mail server that should relay the e-mails. The port default is 587. Probably the e-mail server requires a username and password for the e-mail server to be allowed to relay emails. If the server supported this, TLS encryption for the data to the Email server can be enabled.

The mail addressing can be tweaked by setting the subject value, which will be placed as subject in the e-mails. A sender address can be supplied, e-mails will be sent from this e-mail address. The e-mail server must be setup to parse e-mails from this user. Also, multiple recipients can be supplied: The e-mails will be sent to this e-mail addresses. Administrators can specify more than one recipient by separating them with commas (e. g. "user1@mail.com,user2@mail.com").

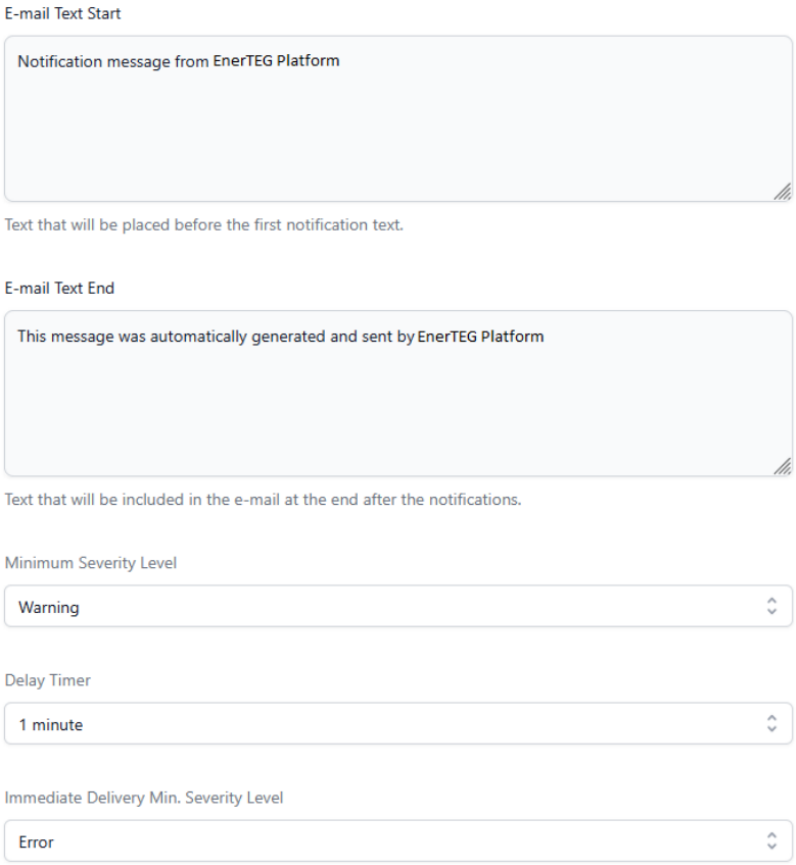


Figure 14. E-mail services

The mail template can be tweaked by setting the text start that will be placed before the first notification text. The end text can also be set, the end text will be included in the e-mail at the end after the notifications. Administrators can set options such as the minimum severity level threshold for sending e-mails; info, log, warning (default) or error. There is also a delay used for sending e-mails (1 min, 5 min, 15 min, 30 min, 1 hour) and the minimum severity level for which an e-mail will be send instantly can be set.

5.8. Audit log

These settings are for controlling the audit log.

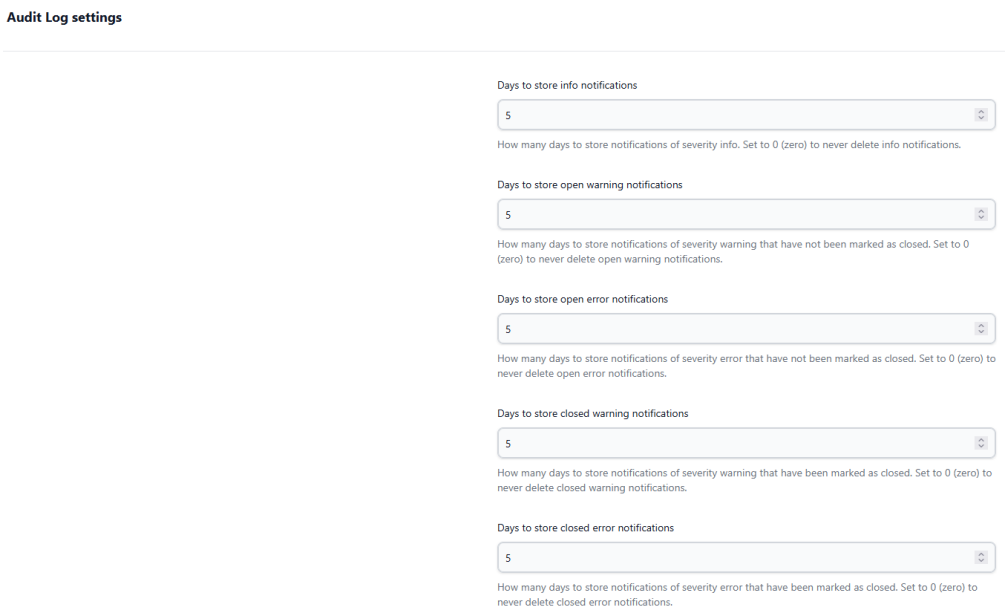


Figure 15. Audit log

In the audit log, there is the ability to set how many days to store notifications of severity info. Set to 0 (zero) to never delete info notifications (default = 5). This can also be done for a severity warning that have not been marked as closed. Set to 0 (zero) to never delete open warning notifications (default = 5). Open error notifications can be stored, choose how many days to store notifications of severity error that have not been marked as closed. Set to 0 (zero) to never delete open error notifications (default = 5). The same can be done for severity warnings that have been marked as closed. and notifications of severity error that have been marked as closed.

5.9. Authentication (user role management)

EnerTEG users can be added and removed. Roles can be assigned to users. They are allowed different access rights depending on their login attributes. These range from full rights to minimal read-only access. Users with the necessary roles can modify device and port names, switch ports and set rules and threshold values.

Role	Access rights
admin	Read/write access to all EnerTEG functions. A user with this role has read and write access to any EnerTEG device or port.
readonly	Read only access to all device data. A user with this role has only read access to all devices and ports. The user cannot change any parameters, or switch any ports.
power	Read only access plus PDU switching. A user with this role can read any data from any device or port, and can also switch outlet ports.
readwrite	Read only access plus device setup. A user with this role can read any data from any device or port, and can also write new data to any device, or port - other than the switch ports.
poweron	Read only access. Devices can be powered on. A user with this role can read any data from any device or port, and can also switch outlet ports on.
poweroff	Read only access. Devices can be powered off. A user with this role can read any data from any device or port, and can also switch outlet ports off.

There are three actions defined per user: assign roles, edit roles and delete roles.

Roles can be assigned to a local user:

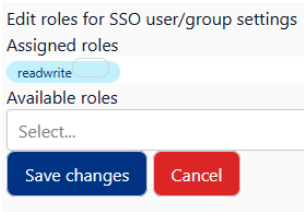


Figure 16. Assign roles

Existing user data can be edited:

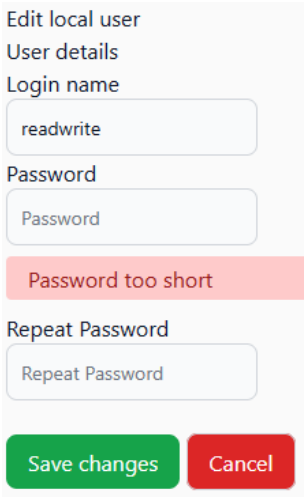


Figure 17. Edit user

New local users can be added to the system:

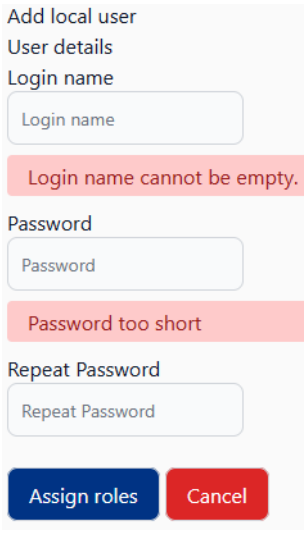


Figure 18. Add user

5.10. LDAP / Active directory

LDAP / Active Directory allows setting up a connection between the system and an LDAP or Active Directory server for authentication and user management.

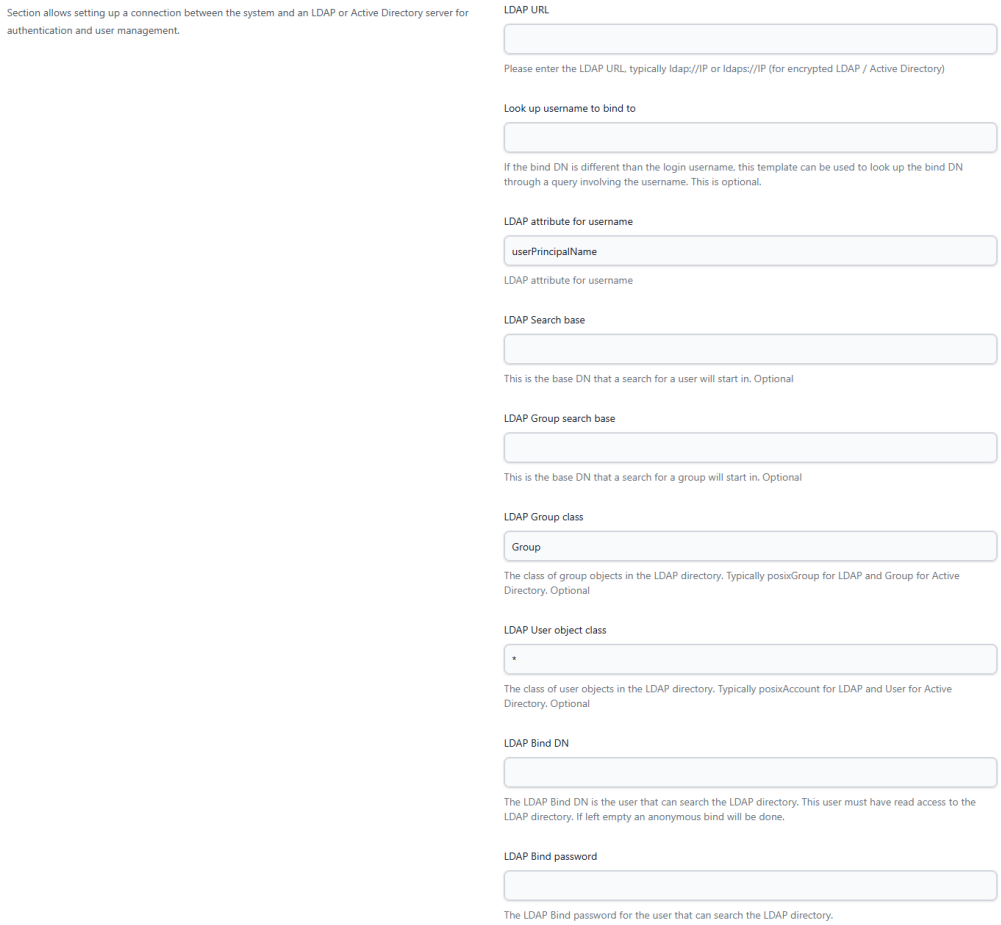


Figure 19. LDAP / Active directory

The LDAP URL can be entered, typically ldap://IP or ldaps://IP (for encrypted LDAP / Active Directory). For Active Directory it is recommended to use port 3269 for encrypted LDAP. If you use a self-signed certificate, please make sure to import it into the EnerTEG TLS Certificates settings. The LDAP Bind DN and password is the user that can search the LDAP directory. This user must have read access to the LDAP directory. If left empty an anonymous bind will be done.

The administrator can configure how the username is mapped from the data returned by LDAP to the username within EnerTEG. If the bind DN is different than the login username, the template can be used to look up the bind DN through a query involving the username. Typically required by LDAP but not by Active Directory. Example: (uid={0}). This is optional. The LDAP attribute of search responses will be used to determine the username. Typically set to cn. Cannot be used with a DN lookup template.

There are multiple (optional) settings such as the search base, which is the base DN that a search for a user will start in. Also the group search base, which is the base DN that a search for a group will start in. The group class of group objects in the LDAP directory can be set, this is typically posixGroup for LDAP and Group for Active Directory. Another optional setting is the class of user objects in the LDAP directory, typically posixAccount for LDAP and User for Active Directory. The LDAP Bind DN is the user that can search the LDAP directory. This user must have read access to the LDAP directory. If left empty an anonymous bind will be done. The LDAP Bind password is the password for the user that can search the LDAP directory.

5.11. CLI

This menu provides configuration options for the SSH CLI service which allows command line access to the system. The TCP port of the SSH server can be set. Defaults to port 22 (or 2022 for non-root installations). Also the hostname or IP address of the SSH server can be provided. If left empty or set to 0.0.0.0, the server will listen on all interfaces.

5.12. TLS Certificates

Multiple TLS certificates can be added to the system.

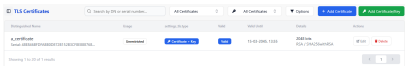


Figure 20. TLS certificates

It is possible to add certificates by dropping supported *.pem, *.crt or *.cer files. A usage restriction can be applied; unrestricted, LDAP connection or device access. A certificate text with PEM content only can be pasted in manually.

Additionally there is the option to add a certificate plus a key manually or via a file upload. Optionally a passphrase can be entered if the private key is encrypted. Supported formats:

- PEM: Text-based format for certificates and keys
- PKCS#12 (.pfx, .p12): Binary format containing certificate and private key
- DER: Binary format for certificates

Chapter 6. Data centre structure

6.1. Overview

A very important EnerTEG feature is provided by the Data centre structure view functionality, which provides a way to access the energy data organised around the customer Data centre and it's structure.

Important values are displayed within the Data centre organisational unit e.g Rack, Room, and thresholds can be set within them. Each organisational unit has it's own dashboard. EnerTEG thus provides a very powerful customer orientated status tuned to their individual requirements.

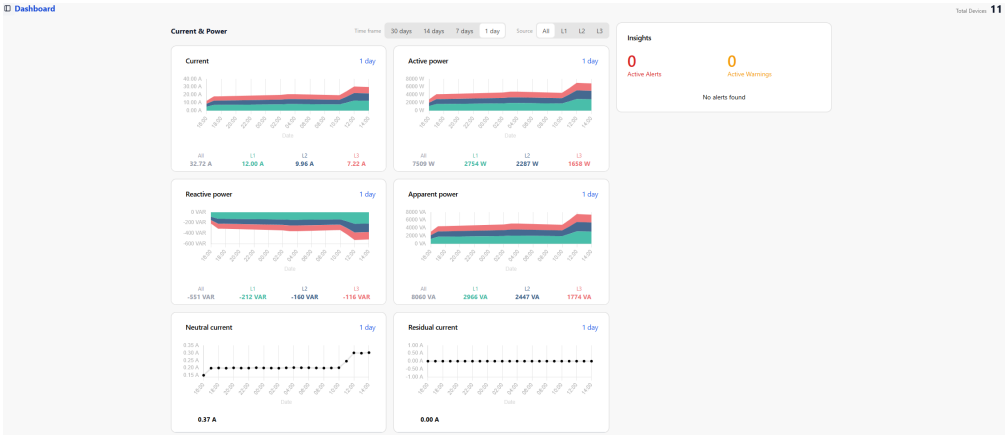


Figure 21. Data centre overview

The Data centre overview provides a logical power overview of the structure in a Data centre. Important energy values are displayed, and their status are made visible within the individual logical groups.

Complete or sections of racks can be switched by a EnerTEG user with the necessary access rights. The user can within this hierarchical view scroll down from the top level view into the required level, e.g. rack with it's installed rack devices.

The initial setup does not include any Data centre structure items such as rooms, etc. These will need to be created after installation in EnerTEG.

6.2. Hierarchy explanation

The Data centre hierarchy is reflected by the elements that are available from EnerTEG. There are a couple of hierarchical options available to make a virtual representation of the Data centre which will be explained in this chapter. In the picture below is an example of a Data centre hierarchical structure fully set up.

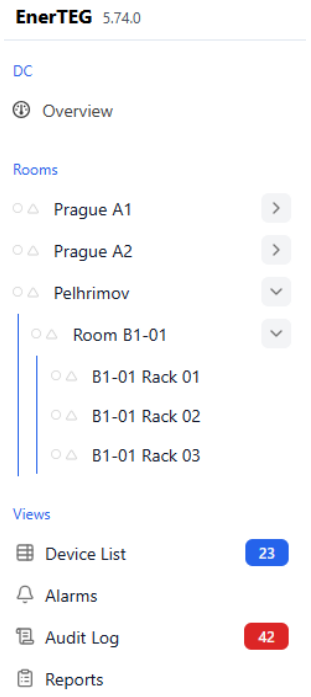


Figure 22. Menu DC Tree

Each structure element in the hierarchy has it's own dashboard with measurements on the level of that structure element.

6.2.1. Data centre

A DC item is a entry to describe a Data centre location.

6.2.2. Room

- Display the selected room by clicking on the relevant room icon on the right side of the view.
- A room is a logical item emulating a Data centre room, and will normally contain a number of rows.
- Select the room by clicking it. This will open the dashboard for that room.
- By expanding the room, the rows in the room will be displayed.

6.2.3. Row

- Display the selected row by clicking on the relevant row icon on the right side of the view.
- A Row is a logical item emulating a row of racks in a room, and will normally contain a number of racks.
- Select the row by clicking it. This will open the dashboard for that row.
- By expanding the row, the racks in the row will be displayed.

6.2.4. Rack

- Display the selected rack by clicking on the relevant rack icon on the right side of the view.
- A rack is a logical item emulating a rack in a row of within a room, and will normally contain a number of PDUs assigned to the rack.
- Select the rack by clicking it. This will open the dashboard for that rack.

6.3. Data centre structure setup

In EnerTEG, a Data centre structure can be set up. Data centres can be added, rooms can be added, rows can be added and racks can be added. This gives users the choice to virtually create the Data centre structure and couple devices. Devices can be coupled to racks. In the device settings, the power feed can be assigned to a device.

This results in measurements on Data centre, room, row and rack level each having their own dashboard. Additionally on rack level there is a device list that contains the devices present in the rack with the ability to assign and unassign devices. When a device is in a rack, the power feed which it is connected to is also displayed on rack level.

To configure the Data centre structure, the menu specially available for this task should be opened. It can be found on the lower left side of the web interface, in the settings section.

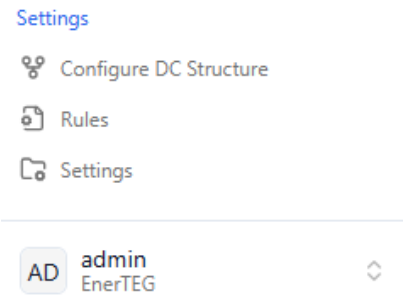


Figure 23. Menu settings

Click on "Configure DC structure". On a fresh installation of EnerTEG, the structure will be empty and can be set up as desired.

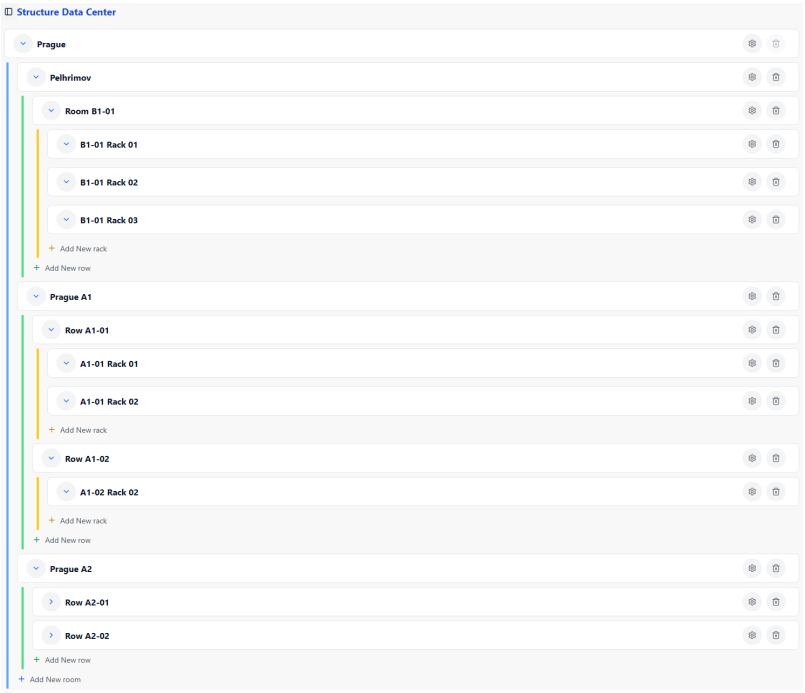


Figure 24. Configure DC Structure

Add a structure element

To add a Data centre structure element, click in the proper place on (example given) 'add new row'. Type in the name and click on add to add the element to the structure.

Modify a structure element

To modify the name of an element, click on the gear icon next to the element. The structure element name now can be changed. Should the modify action require cancellation, click on the cross icon that has become available.

Remove a structure element

It is also possible to remove structure elements by clicking the bin icon. After clicking on the bin once, the icon becomes red. A confirmation is required for removal. Click on the red bin icon to definitively remove the structure element.

Figure 25. EnerTEG

Chapter 7. Operation

7.1. Adding connections/devices

For EnerTEG to function in a Data centre, devices should be added to the system for measurement integration. To add PDUs, the user adds a connection. A connection can contain a single or a range of PDUs in case there are PDUs connected to the databus of the Gateway module PDU. So there is a distinction between a PDU and a connection. When a connection is added to the system, PDUs on that connection are automatically detected by EnerTEG. So in theory, it is possible to add up to 100 PDUs to the system just by adding one connection.

The initial setup does not include any connections, so these will need to be entered. To add a connection to the EnerTEG, open the Setting and navigate to the Connections menu.

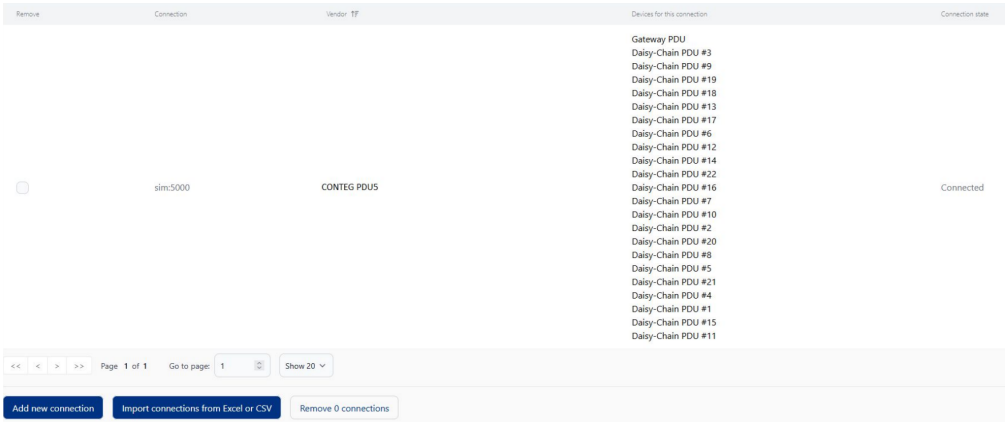


Figure 26. Connections page

The connections page provides a way to manually insert a supported connection with devices that will be accessed by EnerTEG. The added connections are listed in the table, along with status information such as connection details, vendor, found devices and the connection state. Devices can be deleted from this list and will then appear in a “grey” color on the overview page. They will only disappear completely after restarting EnerTEG.

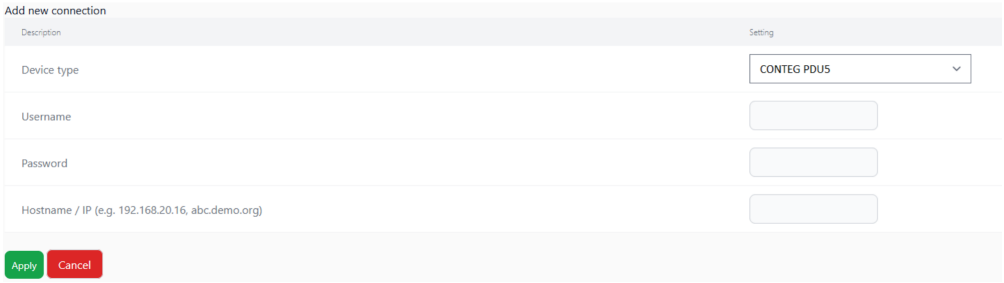


Figure 27. Add new connections

To add a new device, the button Add new connection must be clicked and the data for the new device entered on the right side of the page. It is important to first select the correct device type, so that the correct additional fields can then be entered. After completion press Apply. The EnerTEG gateway will attempt to access the device, which can take several seconds before it goes into a “running” state.

When adding a new connection, make sure to select the correct device type. Besides support for PDU 5.0, there is support to add generation 2/3 PDUs using the WEBAPI protocol.

- Generation 2/3 PDUs via HTTP (unencrypted)
- Generation 2/3 PDUs via HTTPS (encrypted without a certificate)
- Generation 2/3 PDUs via HTTPS (encrypted with a certificate)

SNMP devices will only respond to an SNMP request from EnerTEG when the read community is correct. For this reason, there will not be a EnerTEG error notification when a new SNMP device with wrong community is entered.

Devices that EnerTEG connects to using a web based protocol will typically only allow one user to be logged in from the same account. For this reason, it is probably advisable to create an additional web user with full admin access just for EnerTEG.

7.2. Managing connected PDUs

This section assumes that connections containing operational PDUs are added to the EnerTEG system and that a Data centre structure has been created.

7.2.1. Configure PDUs for use in EnerTEG

When PDUs are added to EnerTEG for the first time, the settings are all at default. For the search functionality and identification within EnerTEG, it works well to do a general and behaviour setup, and optionally do an input, outlet and sensor setup. Go to the device list, click on the PDU that needs configuration. Click on the configuration tab.

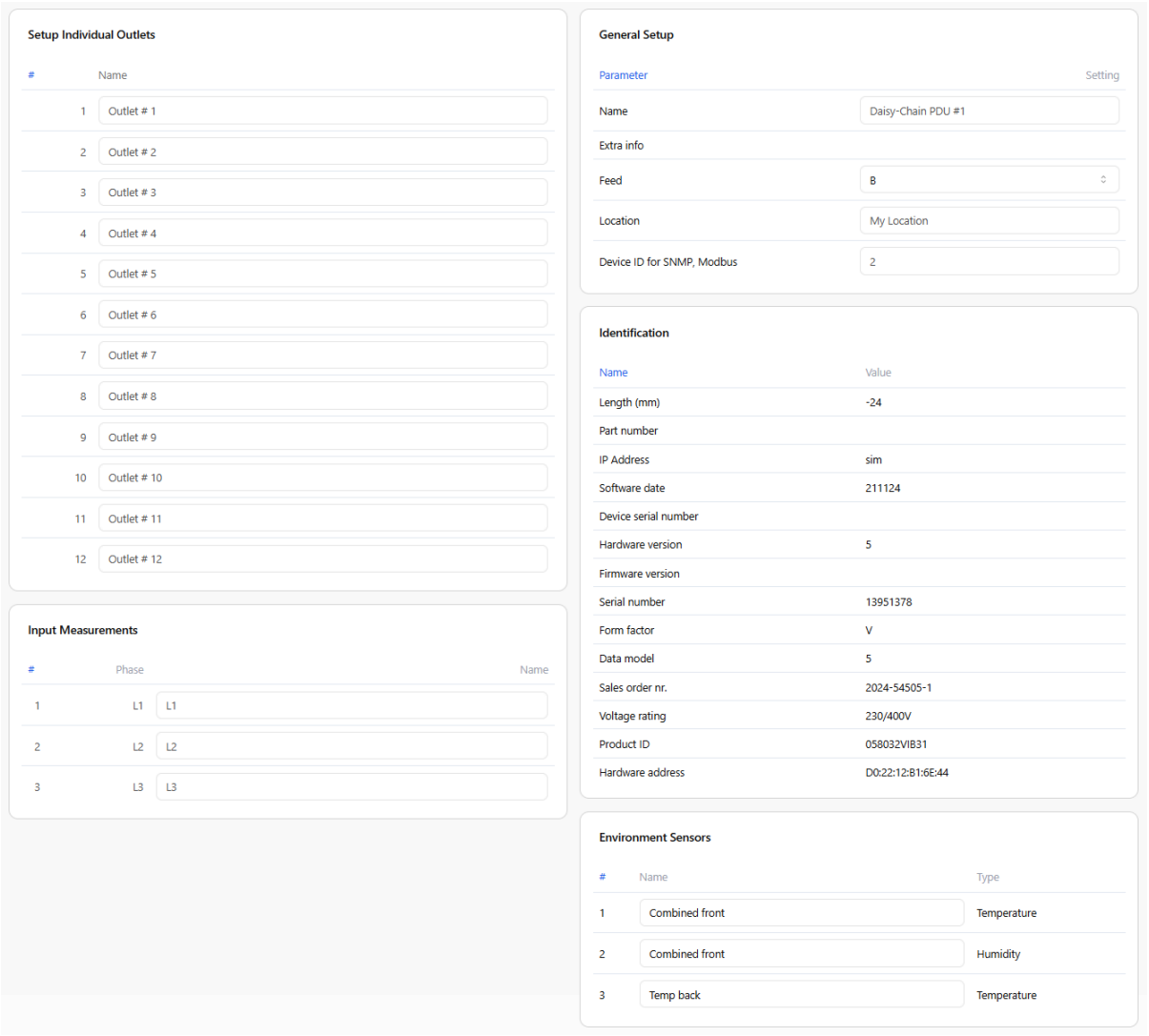


Figure 28. PDU Settings

1. Perform a general setup, the naming, location and extra info makes sure the PDU is easily recognized within EnerTEG. Set up which power feed the PDU is connected to (None, A, B, C or D).
2. Check if the behaviour settings are set up as desired.
3. (Optionally) name the outlets and set up the powercycle and individual outlet delay.
4. (Optionally) name the input phases.
5. (Optionally) name the environment sensors if they are connected to the PDU.

Now the PDU is fully set up and configured to be used in EnerTEG.

7.2.2. Optionally create device specific rules

Should EnerTEG be used in a way where a PDU requires device specific rules (they can also be set system wide), a user can set this before or after adding a device to the Data centre structure. Click on the left side of the web interface on 'Rules'. Now the rules overview opens, showing all the active rules.

1. Click on 'Create new rule'.
2. Click on 'PDUs'.
3. Click on 'One device'.
4. Select the device from the list.
5. Select the type and value of the rule.
6. If desired, further restrict the rule.
7. Enter a name for the rule.
8. Click 'Create rule and set thresholds'.

In the Rules menu, this rule can always be modified or deleted. There is also a report available for each specific rule.

7.2.3. Place PDUs in the Data centre structure

In this step, PDUs known in the system are added to an existing Data centre structure. If a PDU is known in the system but not part of the Data centre structure, it will show in the device list as an unassigned device.

If the user navigates to the device list, there are three filter choices: 'All devices', 'Unassigned' and 'Assigned'. If a device is assigned to the Data centre structure, it will move from unassigned to assigned. If the user wants to have an overview of all unassigned devices, the unassigned filter in the device list can be applied.

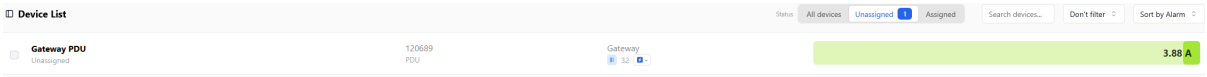


Figure 29. Unassigned devices

If an unassigned PDU is situated in for example rack 4, row 3 in room 2 in a Data centre, the user can navigate in the left menu of the EnerTEG web interface to the virtual representation of that rack if the Data centre structure is set up correct. If the user clicks on that rack, and the dashboard page for that rack will appear. There will be a section called 'Devices in this rack'. If the 'Assign device to rack' is clicked, a device list appears and the user can select the PDU that is in this particular rack by clicking on 'Assign'.

Should a PDU be replaced or removed, or if the user assign an incorrect PDU to a rack; a device can also be unassigned in the rack view to correct this.

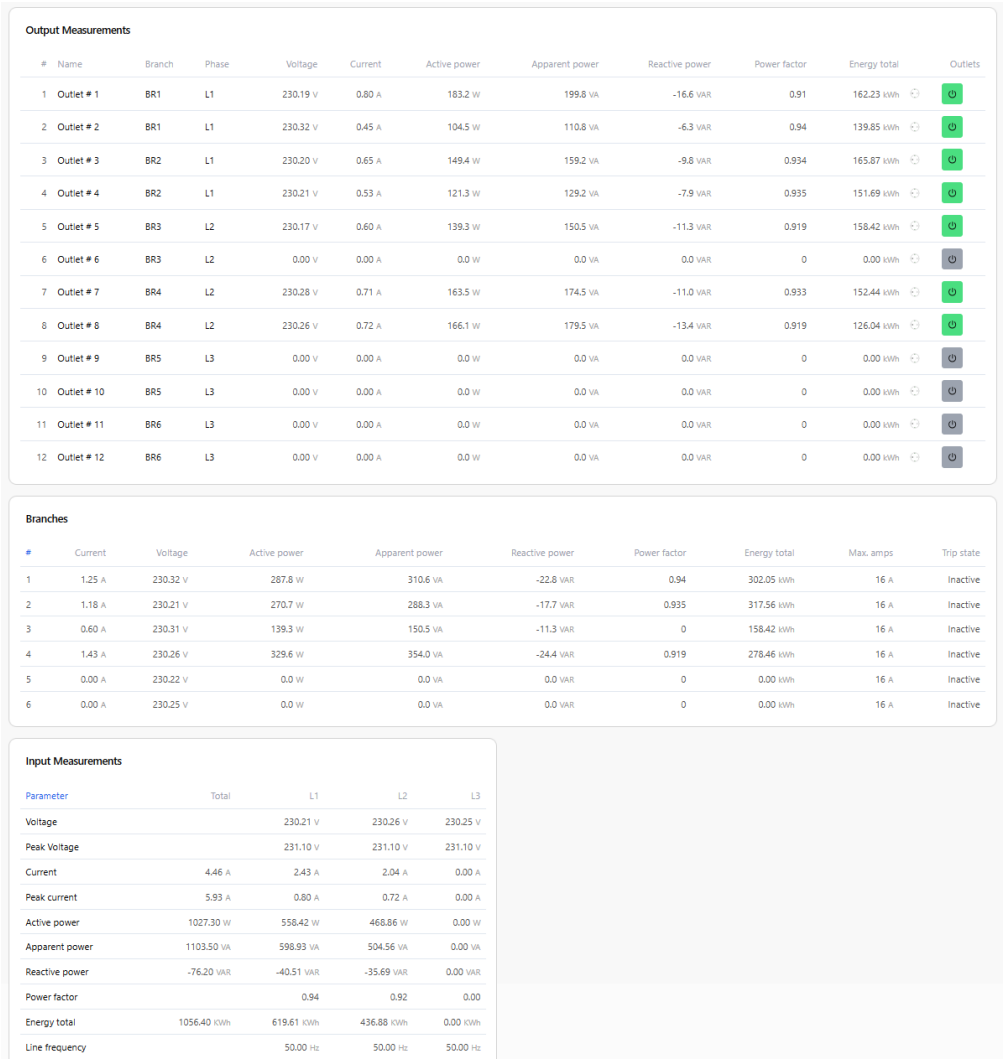
7.3. Measurement monitoring

There are different views for measurements in EnerTEG. There are multiple measurements or inputs, branches, outlets, totals and sensors per device in overview but also detailed measurement views of this data. Combined measurements of PDUs in Data centre structure elements can also be viewed. This chapter goes into detail on how to view these measurements and where to find them.

7.3.1. Per device

To view the measurements per device, first navigate to the device list menu. The device list itself shows the total load on the PDU compared to the maximum load it is rated to handle.

Now an individual PDU can be selected. If the user clicks on a PDU, the device view will load. By default, the information page of that PDU will be shown, which also contains the PDU measurements.



Output Measurements

#	Name	Branch	Phase	Voltage	Current	Active power	Apparent power	Reactive power	Power factor	Energy total	Outlets
1	Outlet # 1	BR1	L1	230.19 V	0.80 A	183.2 W	199.8 VA	-16.6 VAR	0.91	162.23 kWh	
2	Outlet # 2	BR1	L1	230.32 V	0.45 A	104.5 W	110.8 VA	-6.3 VAR	0.94	139.85 kWh	
3	Outlet # 3	BR2	L1	230.20 V	0.65 A	149.4 W	159.2 VA	-9.8 VAR	0.934	165.87 kWh	
4	Outlet # 4	BR2	L1	230.21 V	0.53 A	121.3 W	129.2 VA	-7.9 VAR	0.935	151.69 kWh	
5	Outlet # 5	BR3	L2	230.17 V	0.60 A	139.3 W	150.5 VA	-11.3 VAR	0.919	158.42 kWh	
6	Outlet # 6	BR3	L2	0.00 V	0.00 A	0.0 W	0.0 VA	0.0 VAR	0	0.00 kWh	
7	Outlet # 7	BR4	L2	230.28 V	0.71 A	163.5 W	174.5 VA	-11.0 VAR	0.933	152.44 kWh	
8	Outlet # 8	BR4	L2	230.26 V	0.72 A	166.1 W	179.5 VA	-13.4 VAR	0.919	126.04 kWh	
9	Outlet # 9	BR5	L3	0.00 V	0.00 A	0.0 W	0.0 VA	0.0 VAR	0	0.00 kWh	
10	Outlet # 10	BR5	L3	0.00 V	0.00 A	0.0 W	0.0 VA	0.0 VAR	0	0.00 kWh	
11	Outlet # 11	BR6	L3	0.00 V	0.00 A	0.0 W	0.0 VA	0.0 VAR	0	0.00 kWh	
12	Outlet # 12	BR6	L3	0.00 V	0.00 A	0.0 W	0.0 VA	0.0 VAR	0	0.00 kWh	

Branches

#	Current	Voltage	Active power	Apparent power	Reactive power	Power factor	Energy total	Max. amps	Trip state
1	1.25 A	230.32 V	287.8 W	310.6 VA	-22.8 VAR	0.94	302.05 kWh	16 A	Inactive
2	1.18 A	230.21 V	270.7 W	288.3 VA	-17.7 VAR	0.935	317.56 kWh	16 A	Inactive
3	0.60 A	230.31 V	139.3 W	150.5 VA	-11.3 VAR	0	158.42 kWh	16 A	Inactive
4	1.43 A	230.26 V	329.6 W	354.0 VA	-24.4 VAR	0.919	278.46 kWh	16 A	Inactive
5	0.00 A	230.22 V	0.0 W	0.0 VA	0.0 VAR	0	0.00 kWh	16 A	Inactive
6	0.00 A	230.25 V	0.0 W	0.0 VA	0.0 VAR	0	0.00 kWh	16 A	Inactive

Input Measurements

Parameter	Total	L1	L2	L3
Voltage		230.21 V	230.26 V	230.25 V
Peak Voltage		231.10 V	231.10 V	231.10 V
Current	4.46 A	2.43 A	2.04 A	0.00 A
Peak current	5.93 A	0.80 A	0.72 A	0.00 A
Active power	1027.30 W	558.42 W	468.86 W	0.00 W
Apparent power	1103.50 VA	598.93 VA	504.56 VA	0.00 VA
Reactive power	-76.20 VAR	-40.51 VAR	-35.69 VAR	0.00 VAR
Power factor		0.94	0.92	0.00
Energy total	1056.40 kWh	619.61 kWh	436.88 kWh	0.00 kWh
Line frequency		50.00 Hz	50.00 Hz	50.00 Hz

Figure 30. PDU Measurements

The top table on the information tab contains the outlet measurements.

- For each outlet, it is displayed to which branch and which input it belongs.
- Per outlet that is displayed in the table, there is a name, apparent energy, peak current, energy total, apparent power, reactive power, power factor, crest factor, voltage, active power, current, outlet type and state value available.
- The outlet type is displayed as a symbol.
- The outlet state can be on or off, and if switchable, switched to the opposite state by clicking on the button.

Below the outlet measurement table is the branch measurement tab with similar measurements available if the PDU supports this. The outlet and branch measurements are displayed in real time. There is also the input measurements table. This table contais multiple parameters such as voltage, peak voltage, current, peak current, active power, apparent power, reactive power, power factor, energy total, line frequency, neutral current and residual current. There parameters are available as total, and for the available input phases. The input measurements are displayed real time.

Only PDUs that are configured with measuring capabilities will show the measurements according to it's configuration.

7.3.2. Detailed measurements per device

For all individual PDU measurements, there is a detailed measurement feature available with measurement data over time.

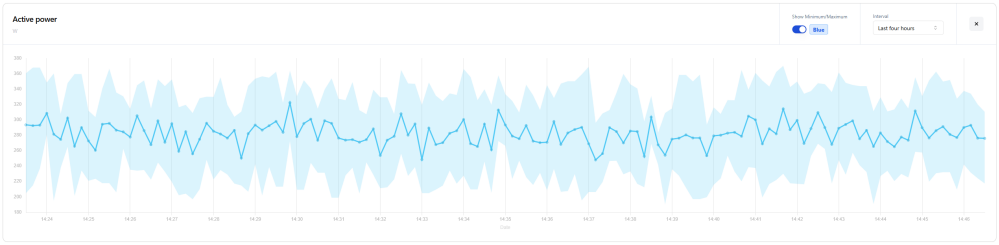


Figure 31. Detailed measurements

The detailed view for PDU measurements can be opened by clicking on a specific measurement in the input or outlet measurement tables.

For each detail view, the minimum and maximum values can optionally be set to on or off. This means the minimum and maximum value on that timespan can be viewed also. The graph interval can be set to real time, last four hours, last three days, last week, last month and last year.

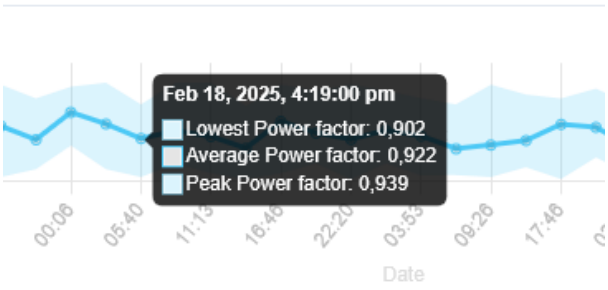


Figure 32. Pop-up with details

When hovering over the graph, a detail pop-up will be available with details and the exact measurement values for the point in time.

7.3.3. Data centre structure measurement view

This chapter described how measurements for different Data centre structure elements can be viewed. There are measurement views available per Data centre, per room, per row and per rack (only if they are created in the Data centre structure). The measurements per Data centre structure element are available in the current & power section of the chosen Data centre structure element.

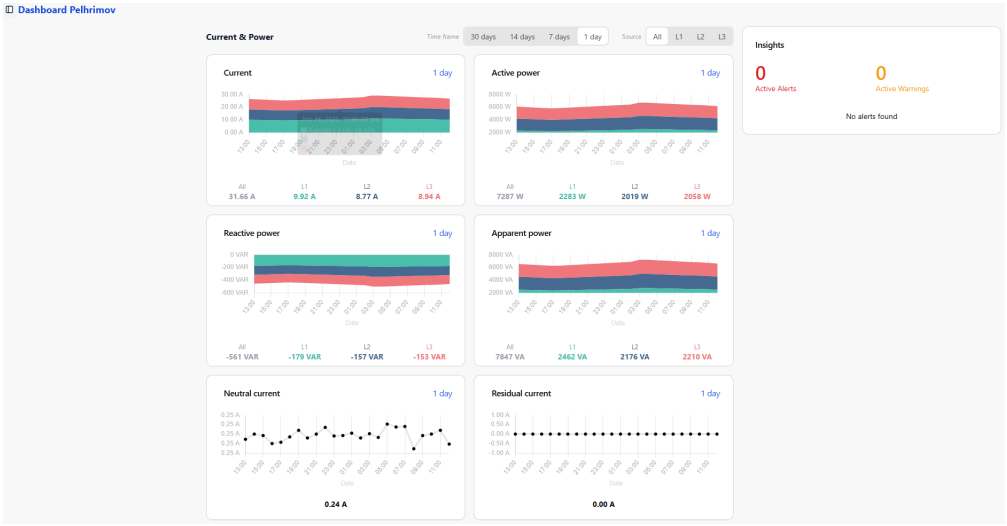


Figure 33. Room dashboard

There are graphs for current, active power, residual current, apparent power, neutral current and reactive power available. The time frame can be selected for these graphs, there are options for 1, 7, 14 and 30 days. Also the source of the measurement data over time can be selected, which is 'all', or per individual phase.

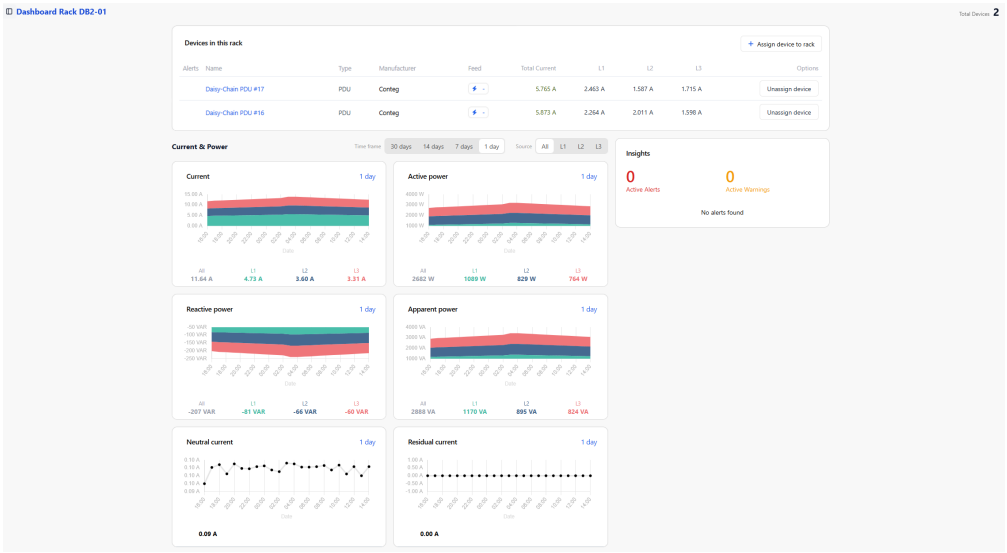


Figure 34. Rack dashboard

The rack view is a bit different in comparison to the view of a Data centre, room or row. Next to the current & power measurement section described in this chapter, the rack page also contains a section of all devices in the rack. For these devices assigned to the rack, the total current and the current per phase is available as measurement.

7.4. Powering on/off outlets

The EnerTEG is able to switch outlets on devices that support outlet switching. The typical way to switch the outlet of an device is to go to the 'Device list' and to click on the device of which the outlets needs to be switched.

When a PDU is clicked, the website goes to the web page for individual PDU data and lands on the 'Information' page. The information page contains the input and output measurements.

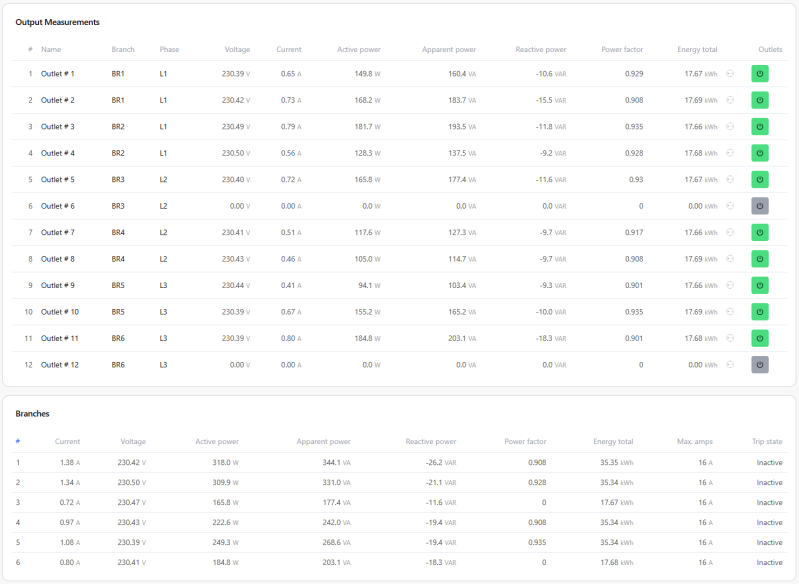


Figure 35. Outlet measurements section

If outlet switching is supported on the PDU, the user will see a state button for each outlet in the output measurements section. These icons are clickable. If the icon is green, the outlet is currently powered. If the icon is grey, the outlet is not powered.

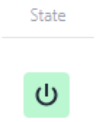


Figure 36. Outlet state icon

When the state icon is clicked, the outlet switch menu appears. If so desired, the outlet can be switched to on or off depending on the current state of the outlet.

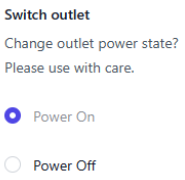


Figure 37. Switch outlet menu

When the outlet is powered on or off, the icon should change and the outlet will switch accordingly. If the PDU is measured, the measurements should appear of disappear depending on the switch choice.

7.5. PDU firmware updates

With each version of EnerTEG, firmware updates for PDU modules are included. EnerTEG is able to update the firmware of the PDUs automatically in the background. It is not possible for a user to manually trigger a firmware update, this is done by EnerTEG. Updating the PDU firmware is done through updating the EnerTEG, which can be done by the user in the EnerTEG Settings.

During the firmware update of a PDU, the LED ring becomes blue. When a firmware update is done, the LED ring of the PDU will become green again.

In case EnerTEG finds PDUs with an older version that it has internally available, first all Gateway module PDUs are updated. After the update has succeeded, EnerTEG is done updating. The Gateway module PDUs will take further responsibility of updating all PDUs that are daisy-chained via the Databus.

Chapter 8. Device view

EnerTEG can collect data from multiple energy and sensoric measuring devices and stores this data long-term. This allows visualization of the data in both tabular form and visualized as charts. PDUs all have ports, measurements and settings which are intelligently monitored and can in some cases be controlled. All devices that are connected to EnerTEG can be found in the device list.

Initially, EnerTEG may not include any devices, these then will have to be added as a connection. Devices can be automatically detected when connected to the Databus of the Gateway module.

As connections are entered, and devices are found on that connection, they will appear in the device list, this can take a short time depending on device connection speed. The contents are then continuously monitored and updated in the available interfaces by EnerTEG. It should not be required to refresh the view from the browser to receive new data, this should update automatically.

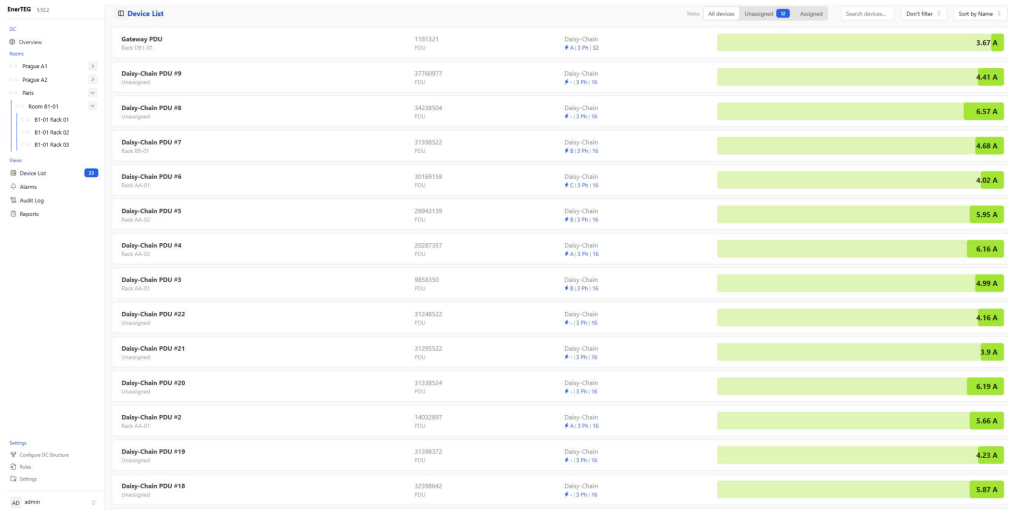


Figure 38. Device list

Devices with an alarm status are shown at the top of the list, and are colored so they can easily be recognized. Depending on the device type the maximum value is displayed with both a slider and a value. The value unit will depend on the device type.

- The total current per PDU will be displayed.
- The device type, the number of outlets and the feed to which the PDU connects to is displayed.

The search field at the top left of the view provides the means to search for device, port or chain names. When an entry is selected, the relevant page and entry will be displayed. There is also a filter box in which the user can filter between all devices, unassigned devices and assigned devices. An unassigned device is not yet added to the Data centre structure. A sorting function can be used to sort devices on alarm, name, type or daisy chain.

8.1. Databus status indication

When Daisychain module PDUs are connected to a Gateway module PDU, the device list will show a visualisation of the Databus ring connection.

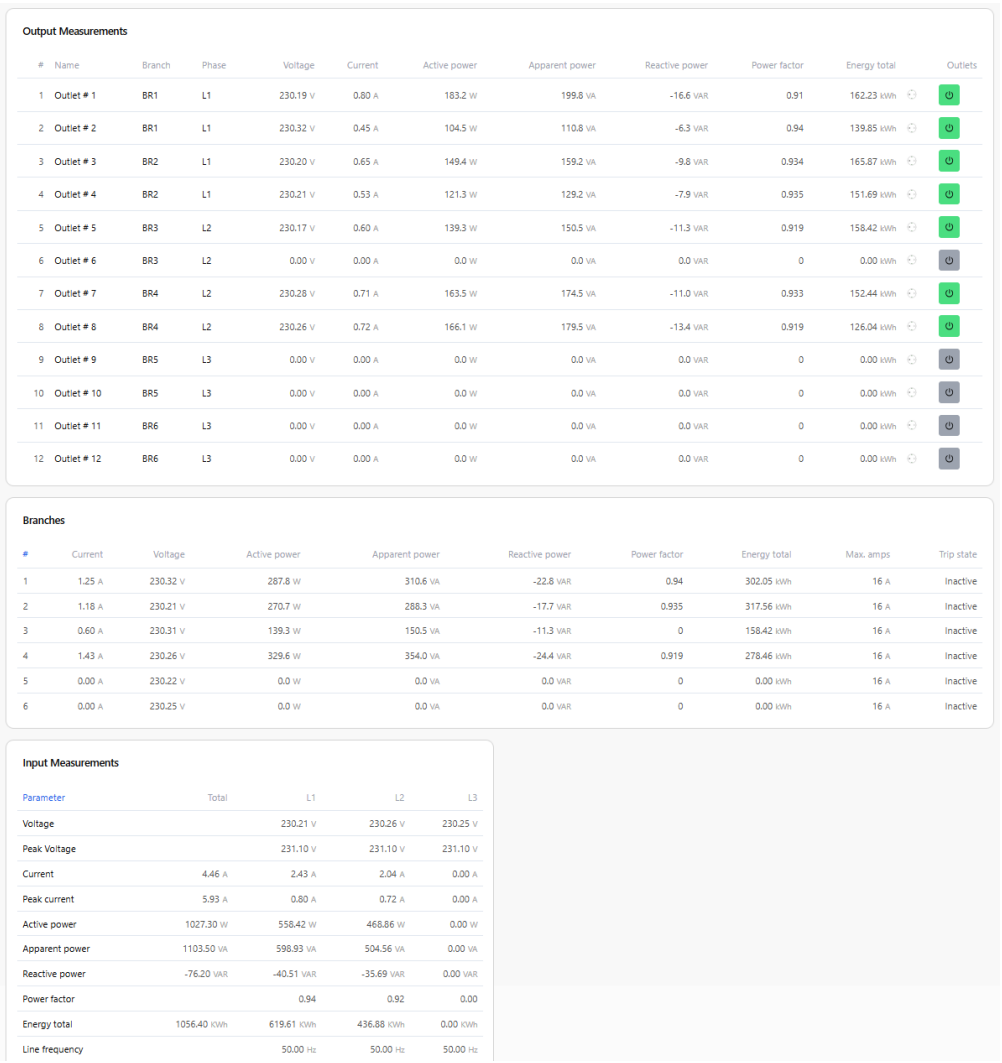
Figure 39. Databus visualisation

For instance if a connection is broken or disconnected and the Databus ring becomes open, EnerTEG is able to determine the exact break location. The break location will be visible in the device list. When a break location appears the cause may originate in one of the devices on either end of the break location, loose / defect connectors or a wiring defect in the cable.

Figure 40. Open Databus ring

8.2. Detail view

To look at a device in detail, the detail view of the device can be selected by clicking on it - the detail view for this device will then be opened. This view provides monitoring for a specific device in the “information” tab. The device settings can also be managed, if user authorisation permits it, by selecting the “configuration” tab at the top right of the view. Any configuration changes made, will be exported back to the device (if supported, such as in PDU 5.0), so that the device status always reflects the status of the values within the device itself.



Output Measurements

#	Name	Branch	Phase	Voltage	Current	Active power	Apparent power	Reactive power	Power factor	Energy total	Outlets
1	Outlet # 1	BR1	L1	230.19 V	0.80 A	183.2 W	199.8 VA	-16.6 VAR	0.91	162.23 kWh	
2	Outlet # 2	BR1	L1	230.32 V	0.45 A	104.5 W	110.8 VA	-6.3 VAR	0.94	139.85 kWh	
3	Outlet # 3	BR2	L1	230.20 V	0.65 A	149.4 W	159.2 VA	-9.8 VAR	0.934	165.87 kWh	
4	Outlet # 4	BR2	L1	230.21 V	0.53 A	121.3 W	129.2 VA	-7.9 VAR	0.935	151.69 kWh	
5	Outlet # 5	BR3	L2	230.17 V	0.60 A	139.3 W	150.5 VA	-11.3 VAR	0.919	158.42 kWh	
6	Outlet # 6	BR3	L2	0.00 V	0.00 A	0.0 W	0.0 VA	0.0 VAR	0	0.00 kWh	
7	Outlet # 7	BR4	L2	230.28 V	0.71 A	163.5 W	174.5 VA	-11.0 VAR	0.933	152.44 kWh	
8	Outlet # 8	BR4	L2	230.26 V	0.72 A	166.1 W	179.5 VA	-13.4 VAR	0.919	126.04 kWh	
9	Outlet # 9	BR5	L3	0.00 V	0.00 A	0.0 W	0.0 VA	0.0 VAR	0	0.00 kWh	
10	Outlet # 10	BR5	L3	0.00 V	0.00 A	0.0 W	0.0 VA	0.0 VAR	0	0.00 kWh	
11	Outlet # 11	BR6	L3	0.00 V	0.00 A	0.0 W	0.0 VA	0.0 VAR	0	0.00 kWh	
12	Outlet # 12	BR6	L3	0.00 V	0.00 A	0.0 W	0.0 VA	0.0 VAR	0	0.00 kWh	

Branches

#	Current	Voltage	Active power	Apparent power	Reactive power	Power factor	Energy total	Max. amps	Trip state
1	1.25 A	230.32 V	287.8 W	310.6 VA	-22.8 VAR	0.94	302.05 kWh	16 A	Inactive
2	1.18 A	230.21 V	270.7 W	288.3 VA	-17.7 VAR	0.935	317.56 kWh	16 A	Inactive
3	0.60 A	230.31 V	139.3 W	150.5 VA	-11.3 VAR	0	158.42 kWh	16 A	Inactive
4	1.43 A	230.26 V	329.6 W	354.0 VA	-24.4 VAR	0.919	278.46 kWh	16 A	Inactive
5	0.00 A	230.22 V	0.0 W	0.0 VA	0.0 VAR	0	0.00 kWh	16 A	Inactive
6	0.00 A	230.25 V	0.0 W	0.0 VA	0.0 VAR	0	0.00 kWh	16 A	Inactive

Input Measurements

Parameter	Total	L1	L2	L3
Voltage		230.21 V	230.26 V	230.25 V
Peak Voltage		231.10 V	231.10 V	231.10 V
Current	4.46 A	2.43 A	2.04 A	0.00 A
Peak current	5.93 A	0.80 A	0.72 A	0.00 A
Active power	1027.30 W	558.42 W	468.86 W	0.00 W
Apparent power	1103.50 VA	598.93 VA	504.56 VA	0.00 VA
Reactive power	-76.20 VAR	-40.51 VAR	-35.69 VAR	0.00 VAR
Power factor		0.94	0.92	0.00
Energy total	1056.40 kWh	619.61 kWh	436.88 kWh	0.00 kWh
Line frequency		50.00 Hz	50.00 Hz	50.00 Hz

Figure 41. Detail view

The data that is available in this view will adapt to the device which is being displayed. In most cases, the data will be extracted dynamically from the device, and the displayed will arrive real time depending on the speed of the device. This data will automatically be collected within EnerTEG memory in 5 second blocks with a maximum, minimum and average calculated for each entry. These blocks are eventually stored on the internal database, which forms the basis of charts that can be viewed by clicking on a relevant measurement value. Historical data will later be changed into hourly and daily blocks, to provide real long term information.

The data is written out from memory to storage at 5 minute intervals, so charting data for a device becomes available after several minutes.

8.3. Input/outlet/branch/total power measurements

The “Input Measurements” table will only be displayed for PDUs that provide measurement per input. The values displayed will depend on the PDU type, and are extracted dynamically during runtime - any changes are marked by flashes. If thresholds have been set then an icon can be seen next to the relevant value. When the threshold is exceeded, an alarm will be raised the entry color will be changed and then is then also visible on the Overview page.

Input Measurements

Parameter	Total	L1	L2	L3
Voltage		230.94 V	230.96 V	230.96 V
Peak Voltage		231.10 V	231.10 V	231.10 V
Current	5.81 A	2.28 A	1.51 A	2.02 A
Peak current	8.37 A	0.79 A	0.73 A	0.79 A
Active power	1342.80 W	526.98 W	349.99 W	465.78 W
Apparent power	1437.30 VA	570.02 VA	375.30 VA	492.02 VA
Reactive power	-94.59 VAR	-43.04 VAR	-25.31 VAR	-26.24 VAR
Power factor		0.94	0.95	0.00
Energy total	176.40 KWh	70.58 KWh	52.92 KWh	52.93 KWh
Line frequency		50.00 Hz	50.00 Hz	50.00 Hz

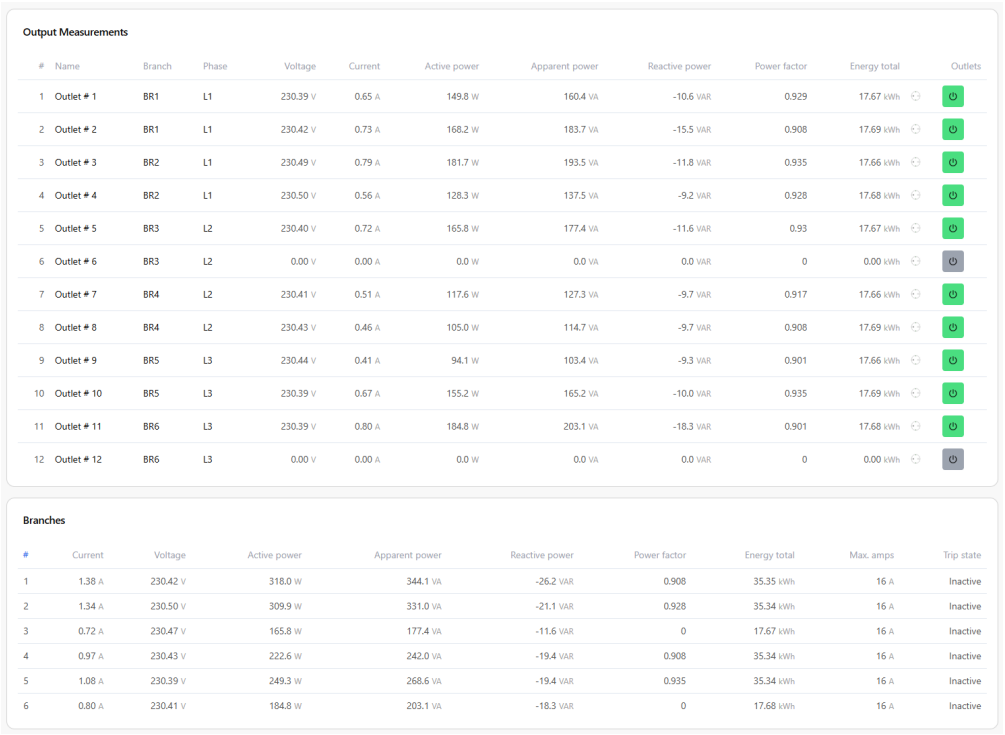
Parameter	Total
Neutral current	0.04 A

Figure 42. Input measurements

The input table is only available for PDUs with measured inputs. Click on individual measurements to open the detail view.

There are multiple measurement parameters available: voltage, peak voltage, current, peak current, active power, apparent power, reactive power, power factor, energy total, line frequency, neutral current, residual current.

Outlet measurements are only available for PDUs with measurable outlets. Depending on the PDU, various field values such as the outlet name can be changed. It may take a few seconds before the PDU reacts and responds to the new configuration. Click on individual measurement values to open the detail view for that measurement.



Output Measurements

#	Name	Branch	Phase	Voltage	Current	Active power	Apparent power	Reactive power	Power factor	Energy total	Outlets
1	Outlet # 1	BR1	L1	230.39 V	0.65 A	149.8 W	160.4 VA	-10.6 VAR	0.929	17.67 kWh	
2	Outlet # 2	BR1	L1	230.42 V	0.73 A	168.2 W	183.7 VA	-15.5 VAR	0.908	17.69 kWh	
3	Outlet # 3	BR2	L1	230.49 V	0.79 A	181.7 W	193.5 VA	-11.8 VAR	0.935	17.66 kWh	
4	Outlet # 4	BR2	L1	230.50 V	0.56 A	128.3 W	137.5 VA	-9.2 VAR	0.928	17.68 kWh	
5	Outlet # 5	BR3	L2	230.40 V	0.72 A	165.8 W	177.4 VA	-11.6 VAR	0.93	17.67 kWh	
6	Outlet # 6	BR3	L2	0.00 V	0.00 A	0.0 W	0.0 VA	0.0 VAR	0	0.00 kWh	
7	Outlet # 7	BR4	L2	230.41 V	0.51 A	117.6 W	127.3 VA	-9.7 VAR	0.917	17.66 kWh	
8	Outlet # 8	BR4	L2	230.43 V	0.46 A	105.0 W	114.7 VA	-9.7 VAR	0.908	17.69 kWh	
9	Outlet # 9	BR5	L3	230.44 V	0.41 A	94.1 W	103.4 VA	-9.3 VAR	0.901	17.66 kWh	
10	Outlet # 10	BR5	L3	230.39 V	0.67 A	155.2 W	165.2 VA	-10.0 VAR	0.935	17.69 kWh	
11	Outlet # 11	BR6	L3	230.39 V	0.80 A	184.8 W	203.1 VA	-18.3 VAR	0.901	17.68 kWh	
12	Outlet # 12	BR6	L3	0.00 V	0.00 A	0.0 W	0.0 VA	0.0 VAR	0	0.00 kWh	

Branches

#	Current	Voltage	Active power	Apparent power	Reactive power	Power factor	Energy total	Max. amps	Trip state
1	1.38 A	230.42 V	318.0 W	344.1 VA	-26.2 VAR	0.908	35.35 kWh	16 A	Inactive
2	1.34 A	230.50 V	309.9 W	331.0 VA	-21.1 VAR	0.928	35.34 kWh	16 A	Inactive
3	0.72 A	230.47 V	165.8 W	177.4 VA	-11.6 VAR	0	17.67 kWh	16 A	Inactive
4	0.97 A	230.43 V	222.6 W	242.0 VA	-19.4 VAR	0.908	35.34 kWh	16 A	Inactive
5	1.08 A	230.39 V	249.3 W	268.6 VA	-19.4 VAR	0.935	35.34 kWh	16 A	Inactive
6	0.80 A	230.41 V	184.8 W	203.1 VA	-18.3 VAR	0	17.68 kWh	16 A	Inactive

Figure 43. Outlet measurements

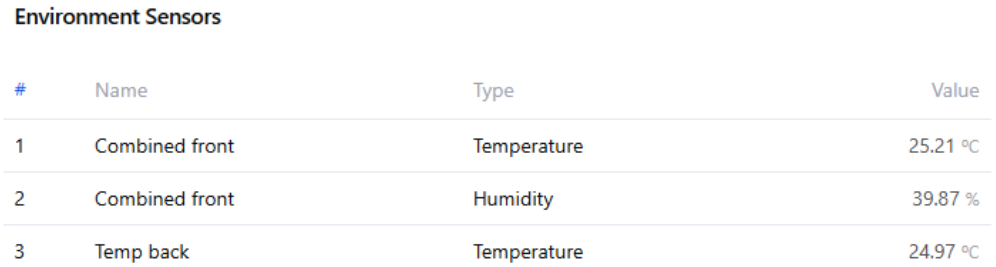
Per outlet that is displayed in the table, there is a name, apparent energy, peak current, energy total, apparent power, reactive power, power factor, crest factor, voltage, active power, current, outlet type and state value available.

The functionality to switch an outlet will only be displayed for PDUs that provide outlet switching. The displayed outlet statuses are extracted dynamically during runtime from the PDU. Authorised users can toggle the switch status of a outlet by first clicking the outlet to “unlock” the switching functionality and then toggling the power state in the pop-up window. It may take several seconds for the PDU to react to the toggle command.

The total measurements for a PDU can be found in the input measurements table. The totals are the calculated values (in the PDU) for all phases, which include: current, peak current, active power, apparent power, reactive power, energy total, neutral current.

8.4. Sensor measurements

Sensors connected to the PDU will be listed in the “Environment Sensors” table. EnerTEG will attempt to identify the attached sensor type, but this is not always possible. The values displayed will depend on the sensor type, and are extracted dynamically during runtime - any changes are marked by flashes.



Environment Sensors

#	Name	Type	Value
1	Combined front	Temperature	25.21 °C
2	Combined front	Humidity	39.87 %
3	Temp back	Temperature	24.97 °C

Figure 44. Environment sensors

If thresholds have been set then an icon can be seen next to the relevant value. When the threshold is exceeded, an alarm will be raised the entry color will be changed and then is then also visible on the Overview page. Depending on the PDU, various field values can be changed. It can take several seconds before the PDU reacts and responds to the new configuration.

Should a sensor be disconnected from a PDU, it needs to be manually removed from the Configuration menu. The remove sensor option will only be available when a known sensor in a PDU is disconnected.

This table is only available when sensors are active on the device.

8.5. Detailed measurement charts

As briefly described in the Operation chapter, a measurement value of a PDU can be clicked which leads to a detail view pop-up. All device data points are collected and processed for the charts. The relevant data point needs to be selected, and its chart will be opened. All charts can be zoomed by using the mouse. The measuring interval can be selected at the top of the chart in the resolution of last four hours, last three days, last week, last month or last year.

8.6. PDU identification

Information provided by the PDU. These values cannot be modified as these are read only values.

8.7. PDU configuration

This table shows the static data for inputs, branches, outlets and sensors provided by the device. Some of these parameters can be changed in Configuration mode. Changing these parameters makes them easily recognizable when an alert is triggered or a rule is made in EnerTEG. For inputs, branches, outlets and sensors, their name can be set. For outlets, there are also fields for setting the individual outlet delay and the power cycle delay. These outlet specific delays will be used by EnerTEG if an power cycle is triggered or when the outlet delay is used depending on the setting of the power-up mode of the PDU on a power failure.

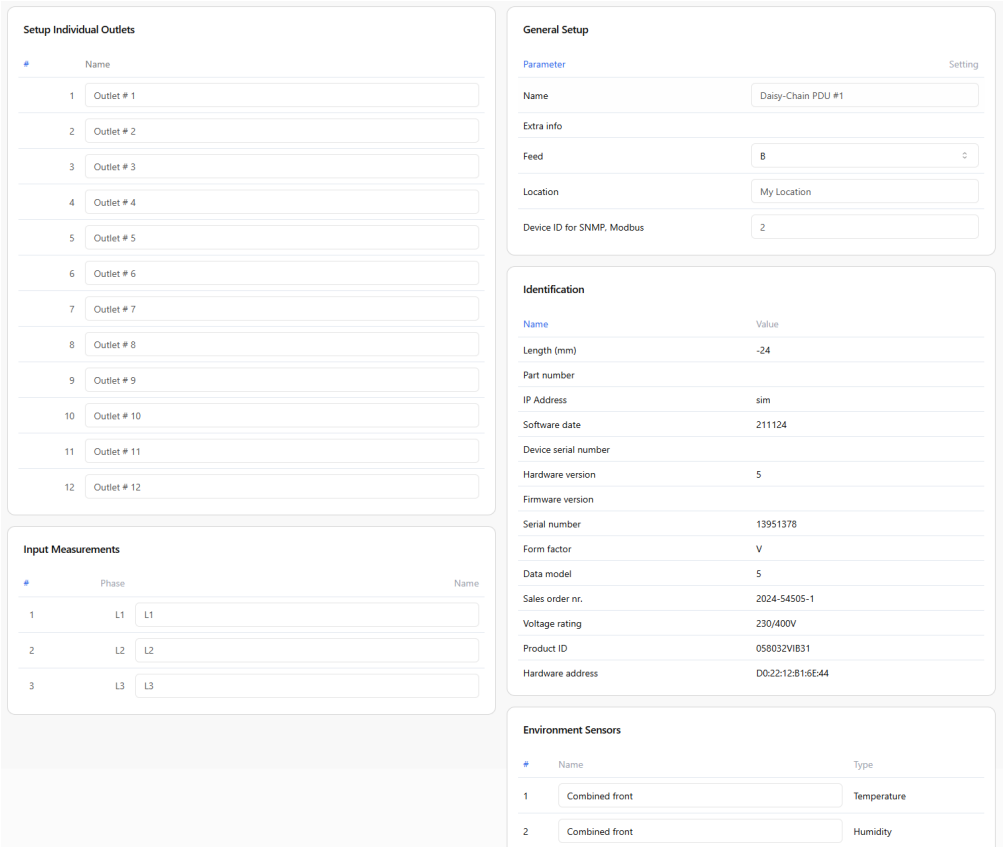


Figure 45. Device configuration

The device configuration is split into three sections; behaviour, diagnostics and the general setup. In the general setup, the “name”, “extra Info”, “location” and power feed information fields can be set. If the device supports these functions, then EnerTEG will export the changed data, otherwise it is only stored locally. The behaviour settings for each individual PDU are also stored in the PDU. The fixed outlet delay contains the value for delay time between two switch actions in milliseconds If a PDU is equipped with switchable outlets, the option to set the power up/down behaviour of outlets on power loss can be configured. The following options are available:

- No switching on power up; At a power loss all outlets are switched off. At power up, all outlets are kept in the off state. This results in the PDU booting up while any power draw on connected devices is prevented.
- System-wide outlet delay; At power loss all outlets are switched off. At power up, all the outlets are set one by one to their last known state by respecting the fixed system-wide outlet delay.
- Individual outlet delay; At power loss, all outlets are switched off. At power up, all the outlets are set to their last known state, but delayed by the individual outlet delay plus fixed system-wide outlet delay
- No switching on power down; In this mode outlets are not switched in case of a power loss, they will be in the exact same state at power on as they were before the power loss.

Chapter 9. Alerts & rules

9.1. Overview

EnerTEG includes a very powerful concept to actively mark events from connected PDUs or Data centre structure items, e.g. a Data centre, room, row or rack via alerts, coloring, notifications and e-mail. The concept is built around creating rules for these items or devices, these can all be created and modified within EnerTEG.

- The Rules menu in the Settings section of the main web interface can be used to create and modify rules.
- The Open Alarms page shows PDU or Data centre structure element alarms, these are instances of thresholds set within a rule that are or were exceeded.

Rules will generally be inserted by the admin, who enters simple commands to initiate events that get triggered when PDU or Data centre structure measurement values change over or below thresholds set by the admin. The events generated by these rules will then be visible on the open alarms page, logged in the audit log, and also included in e-mails and SYSLOG entries if these have been set up. This give multiple options to receive immediate information over data changes, not only from individual measurements on one PDU but possibly from a combination of devices which have a logical dependency on each other. Color coding for all displayed elements immediately shows their status, and therefore any changes are shown immediately based on the rules that are set.

Entries at all levels within EnerTEG are displayed with the most important information inserted and with a background color that reflects their current entity, PDU or measurement status. If multiple statuses are detected within EnerTEG, then the color with the highest priority will be displayed. In the Data centre structure dashboards, the alert will escalate up through the logical levels and be displayed at all levels above the cause and will be mentioned in the insight section of these dashboards.

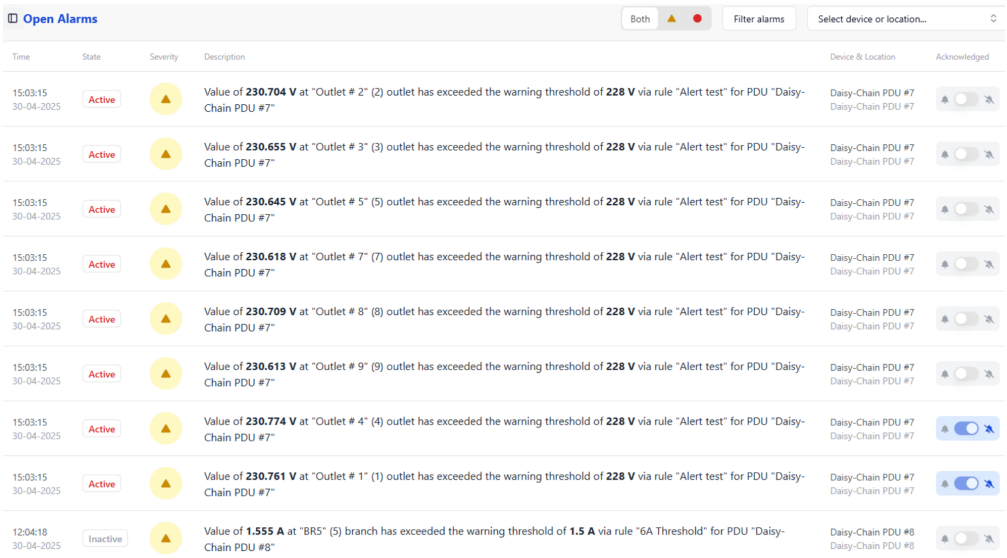


Figure 46. Open alerts

Alerts have a time and date of occurence, a state, severity, description, origin (device), location and an acknowledgement state. The selection box on the open alarms page can be used to display all alarms, only warnings or alerts. There is a filter for acknowledged active alarms, acknowledged inactive alarms, unacknowledged active alarms and unacknowledged inactive alarms.

An alert can be active or inactive which indicates if the threshold in the rule is still being exceeded or not. A user can have the alert unacknowledged (this is the initial state of an alarm) or acknowledged. Acknowledging an alert requires a user action which can be performed on the open alarms page.

In general, the color coding throughout EnerTEG provides a very simple way to have an immediate overview of changes or issues. In most cases a change of status will also cause a notification, which, depending on EnerTEG settings will export an email, or SYSLOG entry.

Color	Description
Red	EnerTEG has detected a value in a critical state.
Yellow	EnerTEG had detected a value in a warning state.
Green	Device or entity ok. No rules exceeded.

9.2. Creating general rules

Rules can be created and modified via the rules page in the settings section. A rule sets an lower warning, upper warning, lower critical or upper critical threshold for a chosen measurement type in all PDUs, a specific PDU, a type of PDU or a Data centre structure element. When a rule is exceeded it will become a warning when the upper or lower warning threshold is exceeded and an alert when the upper or lower critical threshold is exceeded. The rule status is always escalated up through the levels, to provide an immediate overview of PDU specific (measurement) issues or issues within Data centre structure elements such as a Data centre, a room, a row or a rack.

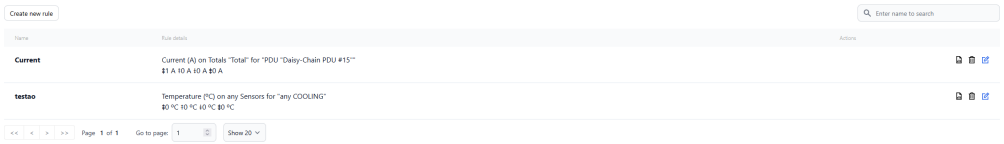


Figure 47. Rules

Rules can be created to match a large number of devices, or specifically for e.g. a single outlet on a specific PDU.

Rules for a large number of devices will generally be thought of as a template, and will be overruled by a more specific matching rule. This allows EnerTEG administrators to create basic rules for all or part of the Data centre item, and then focus on specific rules for special cases

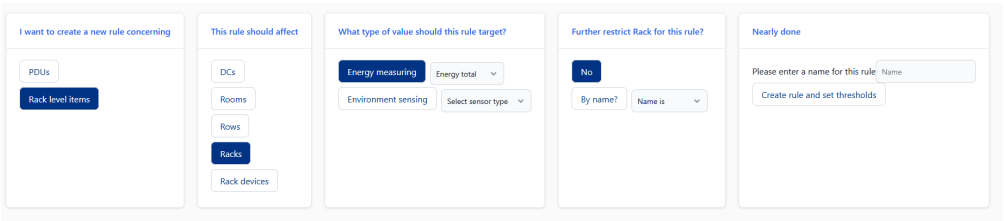


Figure 48. Rule creation

Rules can be created for Data centre structure elements (Data centres, rooms, rows and racks), for all PDUs, a single PDU or a type of PDU. Ther user can select the measurement and even further restrict the rule. A rule requires a name and the setting of the thresholds before it can be created.

9.3. Threshold levels

Rules are given names to help identify them and their purpose. Each rule requires the definition of one or more thresholds.

Figure 49. Rule thresholds

- Critical above: Value measured greater then this value will cause a Critical threshold state to be detected. The PDU(s) or Data centre structure item will be marked in red and a notification created.
- Critical above toggle: Enable or disable the Critical above threshold detection.
- Warning above: Value measured greater then this value will cause a warning threshold state to be detected. The PDU(s) or Data centre item will be marked in brown and a notification created.
- Warning above toggle: Enable or disable the Warn above threshold detection.
- Warning below: Value measured below this value will cause a Warning threshold state to be detected. The PDU(s) or Data centre item will be marked in brown and a notification created.
- Warn below toggle: Enable or disable the Warn below threshold detection.
- Critical below: Value measured below this value will cause a critical threshold state to be detected. The PDU(s) or Data centre item will be marked in red and a notification created.
- Critical below toggle: Enable or disable the Critical below threshold detection.

Chapter 10. Audit log

EnerTEG includes an advanced audit architecture. EnerTEG also displays the list of audit logs, which are in some cases information such as PDUs that are added or user logins, but also include the alarms. Users with the necessary access rights can add comments to the logs, track the state of actions taken to fix issues and directly access information on devices linked to the alarm.

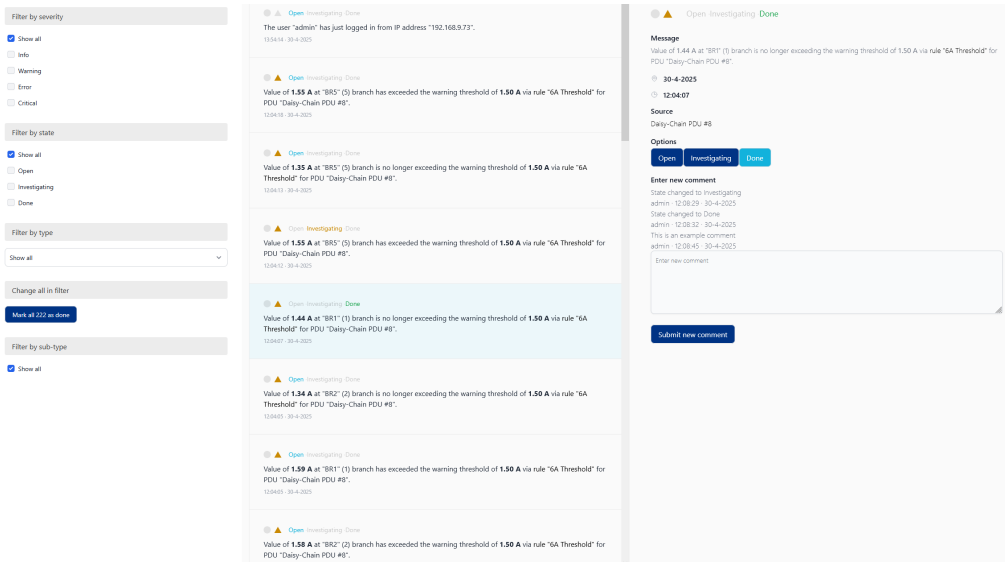


Figure 50. Audit

The audit log lists all the EnerTEG internal events, and their severity. These events can also be sent via E-mail or SYSLOG if required (see “Settings”). The view is in three vertical parts.

- The left section provides various filter mechanisms to select which logs are displayed. The logs can be filtered depending on their severity, or their state.
- The middle section displays a vertical scrolled list of logs. The list will be split into pages when the page limit is reached, the pages can be selected by buttons at the bottom of the view. – The severity is on the top left of each entry. The entry color will depend on the severity level. A detailed entry will be displayed on the right side if clicked. – The possible states are listed below, and can be changed by using the buttons in the detail section of the view. – The associated text for this log. – The date when the log was created.
- The right section is a detailed view of the selected log. The selected log state can be modified within this view, and also comments can be entered. This information will be stored with the log entry.

10.1. Severity

Every notification is generated with a predefined severity level. This level cannot be changed. The severity for a log entry is listed as part of the title. The available severity levels are listed below:

Severity	Description
Debug	Only in debug mode. Development only.
Log	Very low information only.
Info	Information only.
Warning	Warning level, not a critical error.
Error	Error level.
Always	Always logged.

10.2. State

Every notification has a current state. The state is generated in an “open” state, this can be changed for high severity notifications. State changes are also listed in the notification comment field. The available states are listed below:

State	Description
Open	This is the initial state for any newly created Notification.
Investigating	This state can be selected by the “investigating” button.
Done	This can be selected by the “done” button.

Chapter 11. Remote monitoring

11.1. CLI

For EnerTEG Platform, a command line interface is available as a console on the virtual machine or via SSH. The functionality is enabled by default, but can be configured in the CLI menu in the settings of EnerTEG. The command line interface has been modelled on the semantics of a UNIX shell, making it familiar to many administrators.

The CLI interface is primarily intended for performing configuration tasks without using the web interface, or possibly automated configuration via scripting.

Login on the CLI via console: Open the console in the Virtual Machine and type in username and password. Login on the CLI via SSH: 'ssh <account_name>@<ip_address>' and then fill in the password for that user account. The account name and the IP address are parameters that must be filled in with valid data from the customer environment. Please note that after a software update to a newer version of EnerTEG has been completed, the SSH key for access to the CLI will be changed.

The 'tab' key will often offer autocomplete. The arrow keys allow access to the command history. All measurement data, PDU configuration settings and system settings are reachable through 'topics'. Topics can be viewed as folders with subfolders and only one single _data file inside.

The following commands can also be queried on the system by typing 'help'. Help shows a list of commands, modelled to Unix commands.

11.1.1. Commands

Navigation

Command	Description
pwd	Show current path
cd <path>	Change path (support for relative and absolute paths)
ls <path>	List contents (subtopics/ and _data if present)
cat <(path)_data>	Get JSON contents of path or _data file
edit <_data>	Edit _data file in a VIM like editor. Use ':wq' to save, ':q' to quit in the editor
put <key_1="a_value"> <key_2=true>	Edit the value of a key in the _data file

Network

Command	Description
ping <hostname or ip>	Ping a server using a hostname or an IP address
network status (optional <eth0>)	Show the status of all network interfaces or a specific network interface
network config (example <eth0>)	Configure a network interface
network list	List all network interfaces

User

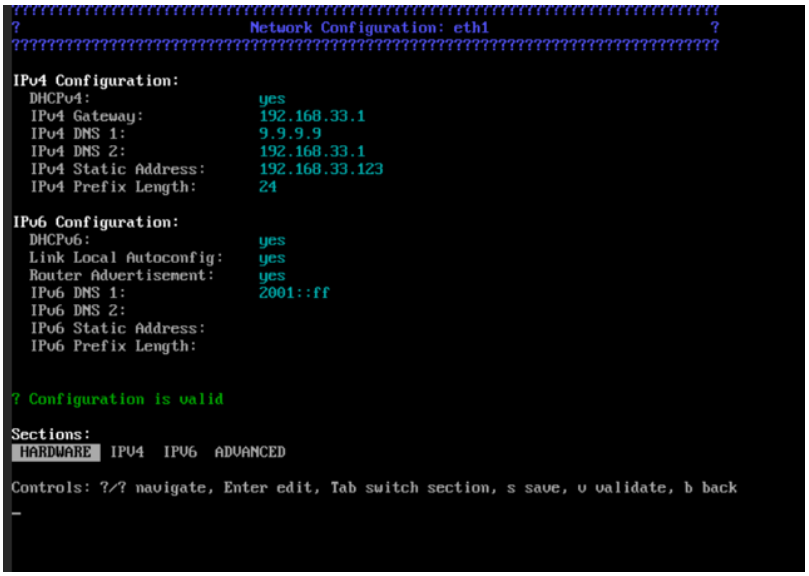
Command	Description
whoami	Show detailed user information
users	Show currently logged users
format <text or json>	Set output format

Command	Description
help	Help shows a list of available commands, modelled to UNIX commands
clear	Clear the terminal session
exit	Terminate

11.1.2. Network configuration

- To view a network, type e.g. ‘network status eth0’ to obtain the network status from the first network adapter available.
- To configure the network settings, type e.g. ‘network config eth0’ to change the network settings of the first network adapter available.

The network configuration configures the ethernet interface and is displayed as a menu-style. Values are sorted in sections, which consist of HARDWARE. IPV4, IPV6 and ADVANCED. Use the Tab key to switch between sections. Press enter to edit a value. After a value has been edited, the settings can be validated by pressing the ‘v’ key. After validation, the new settings can be saved by pressing ‘s’. To exit, press ‘b’



11.1.3. System configuration

The main items in the system can be accessed by using ‘ls’ in the root folder.

To access the system configuration, navigate to config and use ‘ls’ again to view all system configuration items.

```
telnet:admin:config> ls
auth/                   backup/                 backup_settings/
cli/                    core/                   devices/
email/                  hostname/               http_server/
modbus/                 network/                notifications/
snmp_agent/             sppdu5/                 sql_export/
syslog/                 time/
```

These folders can then be further navigated, and also viewed using the 'ls' command and opened by using the cat _data command.

11.1.4. Reading PDU data

The CLI interface is not intended for reading measurement data. For this purpose SNMP, Modbus, REST API, or the Redfish API can be used. So measurement data is displayed in the CLI, but the correct interfaces must be used for monitoring.

```
Changed to: /sensor
telnet:admin:sensor> ls
_data                   1ea94/                  1f669/
1f6c1/                  driver_system/
telnet:admin:sensor>
```

- PDU data can be accessed from the sensor directory
- PDU serial numbers are displayed in hexadecimal, an easy way to identify them is to copy them from the URL bar in the browser when the PDU is selected in the device list.

http://192.168.9.139/devices/1f6c1/config

To obtain basic PDU information:

```
telnet:admin:sensor> cd 1f6c1
Changed to: /sensor/1f6c1
telnet:admin:sensor/1f6c1> cat _data
Getting data from: sensor/1f6c1
{
  "ts" : 1762512213984,
  "name" : "Gateway PDU",
  "rating" : 16,
  "phases" : 3,
  "state" : "RUNNING",
  "type" : "PDU",
  "location" : "My Location",
  "tpl" : "SpPdu5",
  "url" : "sppdu5|http://s:xxx@192.168.9.47/",
  "vendor" : "Schleifenbauer",
  "groupId" : null,
  "shepherdId" : "000c290af33b",
  "unit" : "AMPERE",
  "max" : 48.0,
  "serial" : "128705",
  "connection" : "Gateway",
  "id" : 6,
  "a" : null,
  "w" : null
}
```

Measurements can be accessed by using the ‘ls’ command in the hexadecimal PDU folder

- t = totals
- i = inlets
- o = outlets
- s = sensors
- status = PDU status data
- config = PDU configuration data
- misc = other PDU data

These folders can then be further navigated, and also viewed using the ‘ls’ command and opened by using the cat _data command.

11.1.5. Changing configuration data

The 'PUT' command can be used to make changes to the EnerTEG configuration. Incorrect changes may cause EnerTEG to stop working. With the exception of configuring the network settings, we strongly recommend that configuration changes are performed via the web interface. Can be used for scripting purposes, but is to be used with extreme caution.

In this example, the SNMP functionality in EnerTEG is enabled via the CLI. Note that the goal of this example is to show how to change a configuration parameter, not to get SNMP fully functioning.

```
telnet:admin:> cd config/snmp_agent
Changed to: /config/snmp_agent
telnet:admin:config/snmp_agent> put enabled="enabled"
Value at config/snmp_agent updated successfully.
telnet:admin:config/snmp_agent> cat _data
Getting data from: config/snmp_agent
{
  "ts" : 1763369306162,
  "v" : {
    "agentAddress" : "0.0.0.0",
    "snmpLocation" : "",
    "enabledTrap" : "enabled",
    "snmpContact" : "",
    "v3PasswordAuth" : "set",
    "snmpVersion" : "snmpV2C",
    "enabledWrite" : "disabled",
    "v2cCommunity" : "public",
    "v3PasswordPriv" : "set",
    "v3ProtocolAuth" : "MD5",
    "snmpName" : "",
    "enabled" : "enabled",
    "genericMibEnabledSet" : "disabled",
    "serverTrapPort" : "162",
    "v3User" : "",
    "agentPort" : "161",
    "v3ProtocolPriv" : "DES",
    "serverTrapAddress" : "192.168.9.22"
  },
  "new" : null
}
```

Navigate to the folder of the correct configuration entry, which in this case is the snmp_agent. The snmp_agent is present in the config folder. Now enable the SNMP functionality by using put enabled=”enabled”. SNMP is now enabled, the response was that the configuration parameter was updated successfully. This example also has a ‘cat _data’ command included so the actual change can be observed. More changes to the SNMP configuration can be made this way to get SNMP fully configured.

11.2. SNMP

Simple Network Management Protocol (SNMP) is an Internet Standard protocol for collecting, modifying and organizing information about managed devices on IP networks. The supported versions in EnerTEG, SNMPv2c and SNMPv3, feature improvements in performance, flexibility and security.

The variables accessible via SNMP are organized in hierarchies. SNMP itself does not define which variables a managed system should offer. Rather, SNMP uses an extensible design which allows applications to define their own hierarchies. These hierarchies are described as a management information base (MIB). SNMP operates in the application layer of the Internet protocol. All SNMP messages are transported via User Datagram Protocol (UDP). A default configured SNMP agent receives requests on UDP port 161. The manager may send requests from any available source port to port 161 in the agent.

11.2.1. Specification

There are convenient and easy ways to (test) read and write capabilities of SNMP register values. In principle, SNMP is an interface to read and write registers of the EnerTEG software and the CONTEG PDU. Reading or writing a register using SNMP requires knowledge of the OID structure provides this functionality, which is collected in a MIB file. This MIB file can be downloaded from the SNMP agent menu in EnerTEG.

11.2.2. Configuration

To configure the remote management of EnerTEG via SNMP, the setup of an SNMP agent is required within EnerTEG. The required knowledge of setting up an SNMP agent is described in SNMP Agent section of the Configuration chapter of this manual.

Should a Data centre structure not exist yet and the PDU is not assigned, it’s still possible to add the PDU to an SNMP monitoring tool.

11.2.3. Examples

The MIB file (SNMP OID translation table, used for reference) can be loaded easily into various software so it's possible to navigate with readable object names. It is easy to take the OIDs from the MIB browser and insert them in a DCIM mapping file or for example a Python script. There is also the option to download and install an SNMP tool to make sure the connection is valid first, there are multiple useful tools for exploring the SNMP environment.

1. Launch the SNMP tool / MIB Browser.
2. Go to the settings and make sure the Agent Port is set to the correct port (default: 161),
3. In case of SNMP v2c, set the read community to the read community in EnerTEG (default = "public") and the write Community to the correct one (default = "private") after selecting the correct SNMP version.
4. In case of SNMP v3 this is different, in addition to a username and password, the authentication protocol and the privacy protocol must be set accordingly to the settings in EnerTEG.
5. Create an agent using the settings above. Make sure the IP Address of the EnerTEG Platform is filled in.
6. Make sure the Agent IP is set correctly. Otherwise set this IP address to the correct value and check if the IP is still valid.
7. Download the PDU MIB file from the SNMP agent menu in EnerTEG.
8. Load the MIB file into the software.
9. Now use the application to navigate through different PDU registers values using SNMP and retrieve or write values.
10. Make sure the proper request method is used to read or write the register.
11. To get the all values (also of multiple PDUs if on Databus), perform a "Walk".
12. Some application include a section for receiving traps. Make sure the correct trap port is used and it is enabled in EnerTEG.

While in other SNMP communication, the manager actively requests information from the agent, traps provide the option to send alarms from the agent (EnerTEG) to the manager without being explicitly requested. SNMP traps enables a EnerTEG Platform instance to notify the management station of significant events by way of an unsolicited SNMP message. Destination addressing for traps is determined in an application-specific manner typically through trap configuration variables in the MIB file.

A walk can also be initiated from a command line:

- snmpwalk -v3 -u user -l authPriv -a auth_protocol -A auth_password -x priv_protocol -X priv_password ip_address:port_nr oid
- snmpwalk -v2c -c community_password ip_address:port_nr oid

11.3. Modbus

As Modbus communication is unsecured, make sure that the environment is suitable before enabling Modbus.

11.3.1. Register list

The CONTEG EnerTEG Modbus implementation uses Modbus TCP/IP to read values from PDU registers. This is a Modbus variant used for communications over TCP/IP networks, connecting over a port (default 502). It doesn't require a checksum calculation, as lower layers already provide checksum protection. Modbus provides the possibility to address all devices known in the device list in EnerTEG.

The Modbus register list can be downloaded from: https://download.conteg.com/PDU/IP-S/EnerTEG-dcem/

11.3.2. Modbus API Technical Documentation

The Modbus API technical documentation is available from https://download.conteg.com/PDU/IP-S/EnerTEG-dcem/ and provides the API documentation, including the technical specification and usage examples for reading out actual PDU values.

11.4. Redfish API

The Redfish API is an open, standardized JSON-based RESTful API designed for managing and monitoring. It can also be accessed via HTTPS and provides a standardized schema/model describing hardware components. There is roles and permissions support for admin, operator, and read-only users.

The Redfish API technical documentation is available from https://download.conteg.com/PDU/IP-S/EnerTEG-dcem/ and provides the API documentation, including the technical specification and usage examples for reading out actual PDU values.

To make use of the Redfish API, it needs to be enabled in the general settings of the power management system. To enable the Redfish service, log in to the web interface of the power management system and navigate to the general settings, then go to: Web Server Settings → Redfish API. Make sure the Redfish API is set to 'Enabled' and save the changes.

11.5. REST API

The REST API is available in our monitoring software for custom implementation and scripting. The REST API can be used for retrieving device data but should first be enabled in the monitoring software before use.

The REST API technical documentation is available from https://download.conteg.com/PDU/IP-S/EnerTEG-dcem/ and provides the API documentation, including the technical specification and usage examples for reading out actual PDU values.

Many chapters in the technical documentation provide Curl examples, but any program that can transfer data over HTTP/HTTPS can be used.

Chapter 12. Technical support and warranty

12.1. Technical support

Please contact us in case there are questions regarding our products:

T: +420565300358
E-mail: presales@conteg.com
Website: https://www.conteg.com/

12.2. End User Licence Agreement

The End User Licence Agreement can be found at: https://www.conteg.com/general-business-terms-and-conditions